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CSIR SUBJECT SURVEY O/CHEM 5

DETERMINATION OF THE PARTICLE CONTENT OF FLOWING GASES

An annotated bibliography

E.A. ROUILLARD

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CONTENTS

1 INTRODUCTION
1.1 Scope
1.2 Sources of information
2 BIBLIOGRAPHY
3 AUTHORS' INDEX
4 SUBJECT INDEX

KEYWORDS: Determination, particle, dust, mist, fume, content, flowing, gas, sampling, monitoring, gravimetric, electrostatic, photoelectric, radiometric, acoustical, inertial, error.

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1 INTRODUCTION

Gas streams containing suspended particulate matter occur in most process plants. Information on the mass rate of flow and size distribution of the particles is often required for designing additional equipment, e.g. dust arrestors, or for estimating material losses and assessing plant performance and efficiency. If the gas stream exhausts to atmosphere it is likely that the particulate matter will constitute an air pollution hazard. In these cases a knowledge of the emission rate will be required to ensure that the emission is within acceptable limits.

The generally accepted and most accurate method of measuring the particulate content of flowing gases is by gravimetric sampling. The technique involves the extraction of a portion of the effluent with a probe while maintaining an isokinetic velocity, i.e. the velocity of the aspirated stream is kept equal to that of the main stream. This method has been used with a few refinements since 1911, and the errors that may occur have been studied and reported by many authors. It has, however, several disadvantages for routine measurements, the principle being:

(1) The tests are costly.

(2) They do not provide a continuous record of instantaneous mass flow rates.

A method that would give a continuous indication of the mass rate of flow of particulates has been sought for many years, and monitoring devices which depend on various physical properties of the particles for their operation have been proposed. Although none can reproduce the absolute accuracy of gravimetric sampling, these devices are useful for indicating changes in the particulate concentration.

1.1 Scope

This bibliography is intended to provide a comprehensive source of information on the sampling and monitoring of particulates in flowing gas streams. It also includes methods of measurement which were initially applied to the measurement of dust in still atmospheres but which either have been or may be used in the future for measurements in flowing suspensions. Papers on the measurement of velocity were included only if they referred specifically to gases containing particulate matter. Papers on particle size determination are not included.

1.2 Sources of information

The references given in this bibliography were obtained from the following sources:

Chemical Abstracts
Engineering Index
Fuel Abstracts
Air Pollution Abstracts (APCO)
CSIR Chemical Engineering Group Information Section
CSIR Library

2 BIBLIOGRAPHY

1911

1 BRADY, W. and TOUZALIN, L.A., The determination of dust in blast furnace gas. J. Ind. Eng. Chem. 3, 662-70 (1911). [Chem. Abstr. 6, 66 (1912)]

Dust sampling probe is described and errors resulting from non-observance of isokinetic velocity are discussed.

1915

2 DREW, W.N., The determination of gas volume and dust concentration in the Cottrell process. J. Amer. Soc. Mech. Eng. 37, 676-8 (1915). [Chem. Abstr. 10, 2847^2 (1916)]

Dust sampling probe is described in which isokinetic rate is obtained by means of two static tubes; one in the main gas stream and the other in the sampling nozzle. Dust sample is collected in a paper thimble placed in a holder. *(Original not consulted.)*

1921

3 JENKER, E., The determination of tar, dust and water in generator gas. Stahl Eisen 41, 181-3 (1921) (German). [Chem. Abstr. 15, 3194^9 (1921)]

A method is described in which tar and dust are precipitated in a hot tube filled with pieces of glass. The water and remaining tar pass through to another cold tube where they are precipitated. *(Original not consulted.)*

1922

4 HEMINGWAY, A.J., The determination of dust losses in metallurgical processes as practiced at the Port Pirie works of the Broken Hill Associated Smelters (Pty) Ltd. Australas. Inst. Mining Met., Proc. (47), 237-44 (1922). [Chem. Abstr. 17, 2550^3 (1923)]

A description of standard methods; aspirating small amounts of gases and collecting the dust in filter thimbles. *(Original not consulted.)*

1925

5 ALLNER, W., A new method for measuring the dust in air and industrial gases. Farbe u.Lack. 451, (1925) (German). [Chem. Abstr. 20, 160 (1926)]

Correct sampling rate is obtained by means of the null principle. i.e. equalizing the velocity head in the nozzle to that of the main stream. Filtration mediums are described. *(Original not consulted.)*

6 ALLNER, W., A new method for the determination of dust and other constituents in industrial gases. Braunkohle. 24, 378-83 (1925) (German). [Chem. Abstr. 19, 3074 (1925)]

In the apparatus described, correct sampling velocity is maintained by means of two tubes measuring the velocity heads, one in the sampling nozzle and the other beside it. These are connected to a manometer and zero pressure difference is maintained. The dust sampled is separated by a cyclone followed by a filter, meter and exhauster. If the gas is hot and moist, the probe is electrically heated and a condenser is placed ahead of the meter. *(Original not consulted.)*

7 DRINKER, P. and THOMPSON, R.M., Determination of suspensoids by a.c. precipitators. J. Ind. Hyg. 7, 261-71 (1925). [Chem. Abstr. 19, 2610^9 (1925)]

The construction of a portable a.c. precipitator for the determination of dust, fumes and smokes is described. *(Original not consulted.)*

8 SIEMENS-SCHUKERTWERKE A.G. (W. Feldman inventor), Estimating the dust content of gases. Ger. Pat. 495.907 (Aug. 25, 1925). [Chem. Abstr. 24, 2580 (1930)]

The gas is passed between two insulated surfaces and the capacity changes of these continuously observed. *(Original not consulted.)*

1926

9 ASKANIA-WERKE A.G., CENTRALWERKSTATT DESSAU and BAMBERG, C., Device for determining the quantity of dust in gas currents. Ger. Pat. 475.604 (Jan. 5, 1926). [Chem. Abstr. 23, 3603 (1929)]

The passage of the dust laden gases through an electrically heated tube causes variations in the temperature. The device is particularly applicable to gases containing coal dust. *(Original not consulted.)*

1928

10 MIETHING, H., The Siemens smoke density indicator. Siemens-Z. 8, (4), 245-51 (1928) (German). *(Original not consulted.)*

1930

11 DAVIDSON & CO. LTD. and WHITMORE, J., Extracting and sampling dust from dust laden air or gas flowing in a conduit. Brit. Pat. 351,584 (April 2, 1930). [Brit. Chem. Abstr. B, 826 (1931)]

In the instrument described, the sampling nozzle also serves as a Pitot tube to measure the pressure and velocity in both the main and sample streams. Conduits are also provided in the nozzle for zeroing the inside and outside pressure of the nozzle on the null principle.

12 GROBLI, W.A., Determination of the dust content of gases. Combustion. 1, (10), 31-4 (1930). [Chem. Abstr. 25, 5719 (1931)]

Sampling probe is described; isokinetic sampling rate is recommended; recommendations as to type and size of filters are made. *(Original not consulted.)*

13 NEUMANN, G. and STRÄHUBER, F., Measurement of the amount of dust and tar in generator gas. Arch. Eisenhuettenw. 4, 151-4 (1930) (German). [Chem. Abstr. 25, 2270 (1931)]

Apparatus described consists of a collection and cooling chamber and filter. It is suitable for the collection of the coarse and fine dust coming from the generators over long periods of time. *(Original not consulted.)*

14 SIMON, A.W., A recording dust concentration meter for blast furnace gas. Blast Furn. Steel Plant. 18, 1686-9, 1700 (1930). [Chem. Abstr. 25, 669 (1931)] *(Original not consulted.)*

1931

15 Anon, Guide for the determination of dust in flue gas. Arch. Waermewirt. Dampfkesselw. 12, 296 (1931) (German). [Chem. Abstr. 26, 2575 (1932)]

Government publication consisting of brief notes on the proper sampling and general remarks on the determinations. *(Original not consulted.)*

16 FAHRENBACH, W., Dynamics of dust and its influence on dust measurement. Forsch. Geb. Inzenieurw. 2, (11), 395-407 (1931) (German).

Discusses importance of isokinetic sampling and shows magnitude of errors resulting from non-observance of this condition. *(Original not consulted.)*

17 MACKENZIE, J.W., Recovery of fly ash from pulverized fuel stacks by use of stack sprays (Paper FSP-53-5). Trans. ASME 53, 51-4 (1931).

Discusses method of sampling in boiler flues. Flue divided into equal area and each sampled individually; importance of isokinetic sampling, magnitude of errors resulting from non-observance, and means of obtaining correct velocity. Sampling probe is described fitted with Pitot tube in the main stream and in the nozzle.

18 SIMON, A.W., KRON, L.C., WATSON, C.H. and RAYMOND, H., A recording dust concentration meter and its application to the blast furnace. Rev. Sc. Instrum. 2, 67-83 (1931). [Chem. Abstr. 25, 1708 (1931)]

An instrument is described in which attenuation of light is used to measure the dust concentration.

19 ZIMMERMANN, E., Measurement of flue dust in stack gases. VDI (Ver. Deut. Ing.) Z. 75, 481-6 (1931) (German). [Chem. Abstr. 25, 3464 (1931)] Translated from German, Belov and Associates, Denver, Colorado, 22 pp, Dec. 1, 1970. [Air Pollut. Abstr. 2, (4), 81 (1971)]

Description is given of dust sampling probes equipped with filters placed either inside or outside the gas stream. Results of experiments are given showing the magnitude of errors resulting from anisokinetic sampling and yaw.

1932

20 BEAN, R.D., Smoke density meter. J. Sci. Instrum. 9, 391-2 (1932) [Brit. Chem. Abstr. A, 139 (1933)]

In the instrument described, smoke passes between a source of light and a photo electric cell, the current through which is measured. *(Original not consulted.)*

21 VIETS, F.H., Apparatus for visual measurement of concentration of suspended matter in gases in flues. U.S. Pat. 1.883.168 (Oct. 18, 1932). [Chem. Abstr. 27, 636 (1933). Brit. Chem. Abstr. B, 717 (1933)]

In the instrument described, the light from two lamps, one of which is situated at the remote side of a chamber on conduit of dusty gas is equalized by reducing the current through the brighter one by means of a rheostat calibrated in terms of dust. *(Original not consulted.)*

1933

22 GIBBS, W.E., Apparatus for determining the velocity and/or the dust and/or the mist content of a fluid stream. Brit. Pat. 416.516 (March 30, 1933). [Brit. Chem. Abstr. B, 1041 (1934)]

Instrument described consists of a Pitot tube combined with a thimble holder with means for adjusting the suction rate on the null principle so as to obtain isokinetic sampling. *(Original not consulted.)*

23 LÜTH, F. and GUTHMANN, K., Determination of the dust content of purified and flue gases in steelworks. Arch. Eisenhuettenw. 7, 345-51 (1933) (German). [Brit. Chem. Abstr. B, 1041 (1934)]

A critical review of the efficiency of the various methods in use in steel works for determining the dust content of gases. *(Original not consulted.)*

24 STERN, A.C., The measurement and properties of cinders and fly ash. Combustion 4, 35-47 (June, July 1933). [Chem. Abstr. 27, 4905 (1933)]

Describes reasons for choosing cyclone collector in preference to other methods for determining dust in flue gas. Results of tests on five boilers are given.

1934

25 BAL'SON, B.F., Study of methods for the determination of dust in gases. Izv. Vses. Teplotekh. Inst. (6) 16-23 (1934) (Russian) [Chem. Abstr. 29, 3262 (1935)]

Several methods are described. 13 references are given. *(Original not consulted.)*

26 CALDWELL, W.E., Characteristics of large Hell Gate direct fired boiler units. (Paper FSP-56-2). Trans. ASME 56, 73-5 (1934).

Experimental results are given showing magnitude of errors caused by anisokinetic sampling. *(Original not consulted.)*

1935

27 BLINOV, K.A. and DESHKIN, V.N., Apparatus for the determination of dust in a gas stream. Russ. Pat. 44.714 (Oct. 31, 1935). [Chem. Abstr. 32, 2792 (1938)] *(Original not consulted.)*

28 HARDIE, P.H., Cinder and fly ash measurements. Combustion 6, (9) 10-16 (March, 1935). [Chem. Abstr. 29, 5250 (1935)]

A method and apparatus developed to investigate the effectiveness of dust separating equipment are described. *(Original not consulted.)*

29 ROSIN, P. and RAMMLER, E., Practical fly ash measurement. Braunkohle 34, 505-12, 525-30, 542-6 (1935) (German). *(Original not consulted.)*

30 WILHELMI, A., Apparatus for indicating and recording the dust content of blast furnace gases. Brit. Pat. 443.025 (Feb. 17, 1936). [Chem. Abstr. 30, 4728^9 (1936). Brit. Chem. Abstr. B, 401 (1936)]

A by pass flow of the gas, preferably sampled from a point of mean velocity of the main flow is cleaned from dust by deflection and the collected dust automatically weighed and recorded. *(Original not consulted.)*

31 YUSHMANOV, E.V. and POPIL'SKII, M., Determination of dust in flowing gases. Zavod. Lab. 5, 820-4 (1936) (Russian). [Chem. Abstr. 31, 7702 (1937)]

The gas is passed at known velocity through a small dust trap, which is weighed before and after the experiment. *(Original not consulted.)*

1937

32 GRANT, J., Nephelometry : A new aid in the economical production of steam. Power Works Eng. 32, 23-4 (1937). [Chem. Abstr. 31, 7566 (1937)]

The use of nephelometry in the determination of flue dust is described. *(Original not consulted.)*

33 HARDIE, P.H., Fuel panel discussion on cinder catchers - Resumé of methods for measuring flue dust. Trans. ASME 59, 355-8 (1937)

This paper discusses the various types of probes and filters used in dust sampling with special reference to their application and limitation. The importance of isokinetic sampling is stressed and errors resulting from its non-observance are reported.

1938

34 ANDERSON, E., On the quantitative determination of industrial gas dispersoids. Trans. Amer. Inst. Chem. Eng. 34, 589-601 (1938). 31st Annual Meeting A.I.Ch.E., Philadelphia, November 1938. [Chem. Abstr. 33, 502 (1939)]

Describes experiments conducted to show that the amount of suspended matter in gases, or gas dispersoids, can be estimated correctly by the metered volume filtration method, provided that certain precautions as to the sampling tube gas velocity be taken. This velocity should be less than the main stream velocity and for small sampling nozzles (6 mm) should be about 95 per cent of the latter.

35 GREINACHER, H., Determining the amount of dust and smoke in gases. Swiss Pat. 195.697 (May 2, 1938). [Chem. Abstr. 32, 6912 (1938)] *(Original not consulted.)*

36 ROGAL'SKII, V.M., Apparatus for determining dust in blast furnace gas. Russ. Pat. 52.884 (March 31, 1938). [Chem. Abstr. 34, 5407 (1940)]

Constructional details are given of a device based on the determination of magnetic permeability of the gas. *(Original not consulted.)*

37 GRIFFITHS, J.H. and JONES, T.D., The determination of dust concentration in mine atmospheres. Inst. Mining Met., Trans. 98-99 156-66 (1939-40).

Discusses error resulting from the use of small sampling nozzles (6 mm and less). *(Original not consulted.)*

38 YUSHMANOV, E.V. and ZABIYAKO, V.N., Determination of dust content of gases in sulphuric acid manufacture. Zavod. Lab. 8, 545-9 (1939) (Russian). [Chem. Abstr. 34, 5602^9 (1940)]

Dust is determined by settling in a dust trap having a 1,5 - 2 mm diameter opening and which is filled with glass wool. It is weighed and placed in the gas line until at least 0,1 gm of dust has been collected. *(Original not consulted.)*

1940

39 Anon, The testing of dust extraction plant. Engineering (London) 151, 421, 461, 501 (1940)

Sampling as recommended by B.S. 893/1940 is reviewed and a sampling probe is described.

40 BRITISH STANDARDS INSTITUTION, Method of testing dust extraction plant and the emission of solids from chimneys of electric power stations. British Standard 893 (1940) 52 pp.

Describes methods for conducting dust sampling tests. Five sampling probes are illustrated. The design of flow straighteners is discussed.

41 AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Test code for dust separating apparatus. ASME Power Test Code No. 21 (1941) 29 pp. *(Original not consulted.)*

42 Anon, Sampling gas borne particles. Engineering (London) 152 141-81 (1941).

This article reviews various shapes of baffles used to obtain uniform dust distribution across a duct for the purpose of dust concentration sampling. A dust sampling probe incorporating an electric precipitator is described.

43 ENGEL, J., Flue dust measurement. Waerme. 64, 277-90 (1941) (German). [Chem. Abstr. 36, 5059^6 (1942)]

Apparatus and techniques for separating and determining dust in flue gases are digrammatically described. Points discussed include separation of water at undesirable points and its prevention, the difficulties of measurement at low gas speeds, the comparison of results obtained at widely different gas throughputs, and the determination of the dust measuring points by calculation and by graphic methods. *(Original not consulted.)*

1942

44 BUBAR, H.H., Relative merits of large and small sampling nozzles for dust determinations. Combustion 13, (12), 39-42 (1942). [Chem. Abstr. 37, 4275 (1943)]

Tests showed that more accurate results are obtained with 37 mm than with 6 mm nozzles. *(Original not consulted.)*

1944

45 LAPPLE, C.E., Sampling of process and ventilation gases. Heat. Piping air Cond. 16, 578-81 (1944). *(Original not consulted.)*

1947

46 FITTON, A. and ROGERS, J., The sampling of pulverized fuel. Pulverized Fuel Conference, Harrowgate, England. Pub. by Inst. of Fuel pp 697-723 (1947). Abs. in D.S.I.R. Fuel Abstr. 2, (2), 140 (1947). [Chem. Abstr. 42, 5202h (1948)]

Experiments performed to determine the magnitude of errors when sampling in a unit pulverizing system. Unsuitable sampling nozzles may cause errors, due to disturbance of the streamlines. The errors with straight tubes were smaller than expected. There was a greater error of concentration than of size distribution. Errors resulting from sampling at anisokinetic rates were greater with coarse fuels, and in general it was found that it is better to sample at too high than too low velocity. It is suggested that a star shaped orifice be fitted in the pipe to improve velocity distribution. *(Original not consulted.)*

47 PATRICK, E.A.K., Electrostatic method for determining dust in wet gas. J. Soc. Chem. Ind. (London) 66, 249-53 (Aug. 1947). [Fuel Abstr. 3, 457 (1948)]

A small electrostatic precipitator is described which enables the determination of the dust content of gases, including those which are inflammable or have dew points above room temperature. Results obtained when measuring the dust concentration in producer gas with a dew point of 15°C are given and discussed.

1948

48 Anon. Dust sampling apparatus. Engineering (London) 166 8-9 (1948). [Engineering Index 337 (1948). Fuel Abstr. 4, 3228 (1948)]

Illustrated description of James Howden & Co. dust sampling probe. It is itself first used as a Pitot tube for measuring gas velocity in duct, and then rate of flow through apparatus is matched by making allowance for frictional loss determined for part of apparatus.

49 ARBOGAST, A.H., The quantitative determination of dust in gas. Iron Steel Eng. 25, (10), 82-9 (1948). [Engineering Index 491 (1948). Chem. Abstr. 43, 972b (1949). Fuel Abstr. 5, 1638 (1949)]

Describes sampling technique and calculations for gravimetric determination of dust content, particularly in steel plant furnace flue gases; wet scrubbing and filtration methods; separation and collection of dusts; measurement or metering of gases for various test purposes; moisture determination; note on improved sampling apparatus incorporating woven glass cloth bag; advantages over alundum thimbles previously used. *(Original not consulted.)*

50 RICHARDSON, H., Slide rule solves gas flow and dust sampling problems. Chem. Eng. (New York) 55, (7), 124-5 (1948). [Chem. Abstr. 42 6586g (1948)]

A slide rule is shown for calculations of velocity measurements with Pitot tube, determining vapour pressure and moisture content of air from dewpoint temperature, and determining proper rate of sampling in dust determinations.

1949

51 Anon, Smoke sampling apparatus. Tech. Mod. 41, (5-6) 90 (March 1949). [Fuel Abstr. 6, 2973 (1949)]

An American instrument for sampling dust laden gases is described. The gas is drawn through a cyclone and filter by a pump. *(Original not consulted.)*

52 ARBOGAST, A.H., Sampling for gaseous and solid contaminants in stack gases. Industrial Hygiene Foundation, Chemical and Engineering Conference. Bull. No. 14, p 52-4 (1949). [Fuel Abstr. 9, 604 (1951)]

A non-externally heated sampling probe is described, which should be insulated for gases cooler than 120°C. It was originally designed for use with alundum thimbles, but glass cloth bags have been found superior. Two static pressure tubes are provided so as to maintain isokineticity on the null principles. *(Original not consulted.)*

53 SILVERMAN, L. Sampling of industrial stacks and effluents for atmospheric pollution control. Proc. 1st Nat. Air Poll. Symp., Pasadena, Calif. p 55-60 (1949). Abs. in Iron Age 166, (2), 85-8 (July 13, 1950). [Engineering Index 24 (1950). Fuel Abstr. 10, 1438 (1951). Chem. Abstr. 46, 7689e (1952)]

Methods used for stack effluent, and aerosol sampling are described; collection of sample from stack; methods of determining sampling rate. *(Original not consulted.)*

1950

54 BEATTY, K.O., jnr. and DEAS, J.E., Measurement of smoke. Heat. Piping Air Cond. 22, 107-15 (Oct. 1950). [Engineering Index 1087 (1950). Chem. Abstr. 45, 3143e (1951). Fuel Abstr. 9, 605, 2776, 10, 3355 (1951)]

A brief discussion is given of some of the various methods used, their principle, and what they measure; Ringelmann charts, umbrascope, filter spots, deposit method, optical methods, electrical precipitation.

55 BEST, P.F., Testing for fly ash emission by the small steam plant. Proc. 43rd Conv. Air Poll. Smoke Prevention Ass. Am., Montreal, p 88-91 (1950). Reviewed in Mech. Eng. 72, 904-5 (1950). [Fuel Abstr. 15, 793 (1954)]

Describes sampling location, isokinetic sampling, cost of equipment and calculations.

56 CALAME, H., New method of particle size and dust content determination. Paper to V.D.I. Committee for dust technology meeting, Karlsruhe, October, 1950. Abs. in VDI (Ver. Deut. Ing.) Z. 92, 1005, (1950) (German). [Fuel Abstr. 9, 2781 (1951)]

A method is described for measuring the dust content of a gas by accelerating the gas through a venturi and measuring the pressure drop produced. *(Original not consulted.)*

57 DONOSO, J.J., An improved automatic smoke sampler. Trans. AIME 188, 610-2 (1950) [Chem. Abstr. 44, 3309i (1950). Fuel Abstr. 8, 1392 (1950)]

Details are given of a sampling probe used by the American Smelting and Refining Co. Isokinetic velocity is obtained by matching the pressure in the sampling nozzle to that of a venturi probe.

58 KUNKEL, H.E. and McMAHON, H.E., Collection and quantitative measurements of dusts and fumes in city atmosphere and from individual sources. Proc. Air Pollut. Contr. Ass. p 42-51 (1950). [Chem. Abstr. 45, 6328d (1951). Fuel Abstr. 15, 802 (1954)]

Describes sources of dust formation. Regulations for testing for dust in the Los Angeles County Air Pollution Control District, and apparatus used for the tests. *(Original not consulted.)*

59 STOEKER, W.F., Smoke density measurement. Mech. Eng. 72, 793-798 (1950). Paper presented at the Am. Soc. Mech. Engrs. Semi-Annual Meeting, St. Louis, June, 1950. [Engineering Index 1087 (1950). Fuel Abstr. 8, 2322 (1950), 9, 611 (1951)]

Tests carried out to study factors which influence the correlation between opacity of the gas and the actual weight of solids in suspension are described. These tests included sampling with a conventional probe.

1951

60 APPLEGATE, J.E., Necessary considerations and requirements of a test of solids in effluent gases from stacks by a smoke regulation or air pollution division. Proc. Air Pollut. Contr. Ass. 44, 95-6 (1951). [Fuel Abstr. 15, 797 (1954). Chem. Abstr. 46, 6301f (1952)]

Sampling apparatus and method of operation are described. *(Original not consulted.)*

61 BALLMAN, H.C., Dust collecting testing equipment and interim report on dust collecting equipment for effluent stack gases. Proc. Air Pollut. Contr. Ass. 44, 96-7 (1951). [Chem. Abstr. 45, 6302a (1951). Fuel Abstr. 15, 800 (1954)]

Sampling apparatus and methods are outlined as used at Columbus, Ohio, by the Division of Smoke Regulation and Inspection. *(Original not consulted.)*

62 BREDL, J. and GRIEVE, T.W., A thermal precipitator for the gravimetric estimation of solid particles in flue gas. J. Sci. Instrum. 28, 21-3 (1951) [Chem. Abstr. 45, 5979b (1951). Engineering Index 443 (1951). Fuel Abstr. 9, 2135 (1951)]

An instrument, called a thermal precipitator, is described to collect solids from a representative sample of flue gas. Its advantages over the usual filtering methods are that it does not offer escessive resistance to gas flow, and is capable of retaining the smallest particles present in flue gas.

63 COOLIDGE, J.E. and SCHULZ, G.J., Photoelectric measurement of dust. Instruments 24, 534, 544, 578-80 (1951). [Chem. Abstr. 45, 7830f (1951)]

Available methods for measuring smoke density are discussed. The sensitive 2 phototube apparatus and its bridge circuit are shown in detail. Sampling methods, and a theory of light absorption by dust are given.

64 MAKINO, N. *et al*, Apparatus for electrical determination of smoke dust. Japanese Pat. 4349 (Aug. 7, 1951). [Chem. Abstr. 47, 1996g (1953)] *(Original not consulted.)*

65 STAIRMAND, C.J., The sampling of dust laden gases. Trans. Inst. Chem. Eng. 29, 15 (1951). [Engineering Index 307 (1951). Fuel Abstr. 10 4697 (1951). Chem. Abstr. 46, 6869 (1952)]

In this paper the general principles of sampling of dust laden gases are described, viz., the selection of a suitable location, the use of mixing baffles to correct maldistribution of gas and dust flow, and the need for isokinetic sampling. Construction details of dust sampling instruments are given.

66 STONE, D.E., KANE, L.J., CORRIGAN, T.E., WAINWRIGHT, H.W. and SEIBERT, C.B., Investigation of a photoelectric device for the determination of low concentrations of dust. U.S. Bur. Mines. Rep. Invest. 4782 (1951) 6 pp. [Chem. Abstr. 45, 4911 (1951)]

Solid and liquid impurities in synthesis gases are measured by an instrument which continually compares, by means of a photoelectric cell, the intensity of a light beam passing through the gas and a similar beam passing through clean air.

67 TUBICH, G.E., What to do about air pollution - Testing procedures and equipment. Amer. Foundryman 19, (2), 34-40, (3) 51-7 (1951). [Air Pollut. Abstr. 2 (3), 72 (1971)]

The basic principle of stack and duct sampling is discussed. Particle collection methods are tabulated. Problems associated with sampling cupola gases are cited and velocity adjustment for sampling is mentioned. *(Original not consulted.)*

68 Anon, A field study of performance of three municipal incinerators. University of California, Sanitary Engineering Research Project. Technical Bulletin No. 6. 65 pp. November, 1951.

Determination of particulate material in stack discharges is discussed in Appendix II, pp 58-59. *(Original not consulted.)*

1952

69 DENNIS, R., JOHNSON, G.A., FIRST, M.W. and SILVERMAN, L., How dust collectors perform. Chem. Eng. (New York) 59, (2), 196-8 (1952). [Chem. Abstr. 46, 2857i (1952)]

Method of testing dust collectors by sampling particulates. Dust sampling probe illustrated.

70 FITTON, A., Ash and atmospheric control. J. Inst. Fuel. 25, 178-81 (1952). [Chem. Abstr. 46, 8346i (1952)]

Review of method of measuring the concentration of fly ash in flue gas. *(Original not consulted.)*

71 FITTON, A. and SAYLES, C.P., Collection of a representative flue dust sample. Engineering (London) 173, 229-30, 261-3, 436 (1952). [Chem. Abstr. 46, 6780g (1952). Fuel Abstr. 11, 3643 (1952)]

Gives results of testing program instigated by the British Standards Institution and carried out at the British Fuel Research Station on a model flue; provision made to produce artificially uneven distribution of velocity and dust concentration, so that efficiency of different devices in bringing about uniform distribution could be assessed; test results.

72 FRIEDLANDER, S.K., SILVERMAN, L., DRINKER, P. and FIRST, M.W., Handbook on air cleaning. U.S. Government Printing Office, Washington D.C., 89 pp (1952). Reviewed in Chem. Eng. News 31, 184 (1953). [Chem. Abstr. 47, 9524i (1953). Fuel Abstr. 13, 3048 (1953)]

Chapter III. Performance and evaluation of air cleaning equipment. Isokinetic sampling probes, filters and electric precipitators are discussed.

73 GOODALE, T.C., CARDER, B.M. and EVANS, E.C., Dust particles in high velocity air streams, representative sampling. Amer. Ind. Hyg. Ass. J. 13, 226-31 (1952). [Chem. Abstr. 47, 10783c (1953). Fuel Abstr. 13, 3037 (1953)]

A sampler for use in aircraft in flight is described. It maintains isokinetic flow over a wide range of altitude and air velocities.

74 GUTHMANN, K., Measurement of dust (in industrial off-gases). Brennst. Waerme-kraft, 4, 232-3 (1952) (German). [Chem. Abstr. 46, 8349c (1952)] *(Original not consulted.)*

75 HAWKSLEY, P.G.W., BADZIOCH, S. and BLACKETT, J.H., A cyclone dust sampling probe for large ducts. BCURA (Brit. Coal Util. Res. Ass.) Information circular No. 49, 9 pp. (1952). *(Original not consulted.)*

76 MATSAK, V.G., Methods for the collection of samples of dust, fog and gases in air conduits. Novosti Med. (U.S.S.R.) (26), 88-96 (1952) (Russian). [Chem. Abstr. 49, 13565 (1955). Fuel Abstr. 19, 1852 (1956)]

A collection system is described and schematically illustrated. A graph showing the relation between rate of air current in the conduit and that in the glass sampling tubes of different diameters is presented. The methods used for the collection of test samples under a variety of practical conditions are fully described, nomograms for the calculation of results are presented, and then application is explained. *(Original not consulted.)*

77 NOSS, P., Procedure and equipment for measuring the dust content of flowing gases. Brennst. Waerme-kraft, 4, (7), 227-33 (1952) (German). Abs. in Eng. Dig. 13, (10), 347-50 (1952). [Chem. Abstr. 46, 8349 (1952). Engineering Index 270 (1952). Fuel Abstr. 12, 3939 (1952)]

Describes work carried out by the V.D.I. Dust Measuring Committee, and gives details of various dust measuring devices. *(Original not consulted.)*

78 SMITH, B.C. and CARLISLE, S.S., A recording dust meter. J. Iron Steel Inst. (London) 171, 273-6 (1952). [Chem. Abstr. 46, 8425e (1952). Engineering Index 270 (1952). Fuel Abstr. 12, 2992 (1952)]

An optical device is described in which the scattered light flux produced by the dust particles and measured by a photo electric cell in a direction normal to the illuminating beam is used as a measure of the dust concentration.

79 STAIRMAND, C.J., Collection of representative flue dust sample. Engineering (London) 173, 436 (1952). [Fuel Abstr. 12, 849 (1952)]

The method of A. Fitton and C.P. Sayles (see Ref. 72) is criticized, for they use a nozzle in place of a half area disc which can be turned out of the way when not in use, and which gives a reasonably uniform concentration over the whole cross section at the sampling plane.

1953

80 Anon, Dust sampling. Elec. Rev. (London) 153, 498 (1953).

A sampling probe approved for use by the British Electricity Authority is reviewed.

81 Anon, Dust sampling equipment. Elec. J. 151, 717-8 (1953). [Fuel Abstr. 15, 799 (1954)]

Dust sampling probe approved by the British Electricity Authority is described. This equipment is the same as that mentioned in Memorandum GO/0326/ET of the B.E.A. The probe incorporates a cyclone and glass wool or slag wool filter and is electrically heated to prevent condensation. Multipoint sampling as recommended in B.S. 893_1940 is envisaged with reservations in respect of dust and gas velocity distribution across sampling plant.

82 Anon, Field testing of stack dust emission needs simplifying. Power 97, (8), 76-7 (1953). [Engineering Index 995 (1953). Fuel Abstr. 15, 792 (1954)]

The various factors involved in assessing stack dust loadings are discussed and the inconvenience of applying the ASME power test code described. The use of an optical device called the "Smokescope" is mentioned. *(Original not consulted.)*

83 HAINES, G.F. and HEMEON, W.C.L., Measurement of dust and fumes in stack gases. Industrial Hygiene Foundation of America, Information Circular No. 5 (1953). Part I - Procedures for stack dust sampling at one point. Part II - Minimizing errors due to departure from isokinetic sampling.

84 HEMEON, W.C.L., Measurement of air pollution. Instruments 26, 566-8 (1953).

Reviews properties of fine and coarse dusts emitted from stacks and the methods available for the measurement of their concentration.

85 HOLTON, W.C. and SCHULZ, E.J., Some notes on dust sampling equipment and technique. Trans. ASME 75, (7), 1327-31 (1953). [Engineering Index 287 (1953). Fuel Abstr. 15, 3215 (1954)]

This paper summarizes the results of the work done at Battelle Memorial Institute. The equipment described has been used for dust sampling of flue gas from spreader stokers, pulverized coal burners and locomotives. The reproducibility of the tests is described.

86 JOHNSON, H.C., Conducting field tests to determine dust emissions from stacks. Air Repair 3, 6-8 (Aug. 1953). Proc. Air Pollut. Contr. Ass. 1953 p 6-8 (1954). Abs. in Ind. Hyg. Dig. 17, 37 (Oct. 1953). [Chem. Abstr. 48, 6625b (1954). Fuel Abstr. 15, 3217 (1954)]

The basic equipment for stack tests is listed and procedures are discussed. *(Original not consulted.)*

87 RAMMLER, E. and BREITLING, K., The development of external filter apparatus for the measurement of flue dust. Energietechnik. 3, 6-15 (1953) (German). [Chem. Abstr. 49, 8584 (1955). Fuel Abstr. 14, 1616 (1953), 18, 4647 (1955)]

Paper deals with absolute filters for the collection and analysis of flue dust. These are defined by eleven items of specification. *(Original not consulted.)*

88 SMITH, J.H., ROUNDS, G.L. and MATOI, H.J., Some problems encountered in sampling open hearth stacks. Proc. Air Pollut. Contr. Ass. 1953, p 35-40 (1954) Air Repair 3, 35-40 (Aug. 1953). [Chem . Abstr. 48, 6625g (1954). Fuel Abstr. 15, 3218 (1954)]

Discusses problems encountered in sampling open hearth furnace emissions and reviews typical sampling procedures and equipment. A small electrostatic precipitator suitable for these emissions is described. *(Original not consulted.)*

89 WALKER, V., Dust sampling of waste gases. Cheap Steam 37, 21-24 (Apr. 1953). [Fuel Abstr. 14, 2611 (1953)]

A general description is given of the method and apparatus used for sampling and grading dust in flue gases. *(Original not consulted.)*

1954

90 Anon, Measuring dust content of blast furnace gas. Engineering (London) 177, 146 (1954).

Describes a photoelectric recording dust meter developed under guidance of British Iron and Steel Research Association.

91 AVY, A.P. and RAILLERE, R., An apparatus that may be used in the factory for the continuous measurement of the dust content. 2nd Conference on industrial dusts, Strasbourg, October 1954 (French). *(Original not consulted.)*

92 DENNIS, R., FIRST, M.W. and SILVERMAN, L., Dust collectors tested in the field. Chem. Eng. (New York) 61, (5), 187-9 (1954). [Chem. Abstr. 48, 9759 (1954)]

A brief report of dust sampling methods described more fully in Ref. 70.

93 DRINKER, P. and HATCH, T., Industrial dust. McGraw Hill Book Co. Inc., New York, 2nd ed. 401 pp. (1954). Reviewed in Ind. Hyg. Dig. 19, 1 (Jan. 1955). [Chem. Abstr. 49, 2645e (1955). Fuel Abstr. 17, 5604 (1955)]

Chapter 8 and 9 reviews dust measurement in still air, but gives description of cascade impactor, impinger and thermal and electrostatic precipitators used in sampling.

94 HEMEON, W.C.L. and HAINES, G.F., A new method for stack dust sampling. Air Repair 4, (3), 165-9 (1954). Presented at Amer. Soc. Mech. Eng. Meeting, June 22, 1954, paper 54-SA-74. [Fuel Abstr. 16, 6218 (1954)]

Gives results of tests done with manifold-nozzle assemblies to achieve more effective coverage of duct cross section.

95 HEMEON, W.C.L. and HAINES, G.F., The magnitude of errors in stack dust sampling. Air Repair 4, (3), 159-64 (1954). Presented at Amer. Soc. Mech. Eng. Meeting, June 22, 1954, paper 54-SA-73. [Fuel Abstr. 16, 6217 (1954)]

Reviews assembly of various elements that may be used in the collection of a representative sample of dust from a stream of dust laden gases, and presents results of studies on the magnitude of errors inherent in the conventional sampling procedures.

96 HORSMAN, H.S., Flue dust sampling in power stations. Elc. J. 153, 1758-61 (1954). [Fuel Abstr. 17, 4761 (1955)]

Dust sampling equipment developed by the British Electric Authority and current dust sampling techniques are described. (See Ref. 81 and 82 for other articles on the B.E.A. apparatus.) *(Original not consulted.)*

97 KANE, L.J., WAINWRIGHT, H.W., SHALE, C.C. and SANDS, A.E., Determination of solid and liquid impurities in synthesis gas. U.S. Bur. Mines, Rep. Invest. 5045, 23pp (1954). [Chem. Abstr. 48, 7878g (1954)]

Discusses selection of sampling site, isokinetic sampling, filters, weighing procedure and moisture determination.

98 WATSON, H.H., Errors due to anisokinetic sampling of aerosols. Amer. Ind. Hyg. Ass. Quart. 15, (54), 21-5 (1954).

This paper presents a theory of the errors resulting from anisokinetic sampling, yaw and nozzle size.

99 Anon, Dust and grit. BCURA (Brit. Coal Util. Res. Ass.) Quart. Gaz. (26), 13-16 (1955). [Fuel Abstr. 18, 4646 (1955)]

Describes a new dust sampling probe. *(Original not consulted.)*

100 Anon, Testing grit arrestors. Engineering (London) 179, 377 (1955) [Fuel Abstr. 18, 1841 (1955)]

Brief description of sampling equipment in which the dust sample is separated in a small cyclone.

101 BURKE, E., Dust arrestment in the cement industry. Chem. Ind. (London) 34, 1312-19 (1955).

Dust Measurement in cement plants is described. Two sampling probes are described. One is the Alundum dust sampler and the other is the Lodge Cottrell type.

102 FEIFEL, E. and PROCHAZKA, R., New method of measuring dust in gases. VDI (Ver. Deut. Ing.) Z. 97, (4), 113-7 (1955) (German). Engineering (London) 183, 235-6 (1957). [Engineering Index 274 (1955); 293 (1957)]

An electrostatic apparatus for measurement of dust, suitable for direct regulation, supervisory control and other applications is described.

103 GUTHMANN, K., New experience in dust concentration measurement in industrial gases. Stahl Eisen. 75, (23), 1571-82 (1955) (German). [Engineering Index 285 (1956). Fuel Abstr. 20, 844 (1956)]

Quantitative measurements; filtering materials used; large and small type dust measuring apparatus; calculation of dust content; possible errors in selection of point of sampling; suction rate of partial gas flow; velocity probe; problem of blast furnace waste gases.

104 IINOYA, K., A new dust sampler of filter type. Kagaku Kogaku 19, 356-61 (1955) (Japanese). [Chem. Abstr. 19, 12045b (1955)]

A dust sampling probe is described with wich isokinetic sampling is done using a null nozzle. *(Original not consulted.)*

105 KNOP, W., Measurements of dust concentration in cement works. Zentralbl. Arbeitsmed. Arbeitsschutz. 5, 72-5 (May 1955) (German). Abstract in Bull. Hyg. (London) 30, 776 (Sept. 1955). [Fuel Abstr. 19, 856 (1956)]

A probe is described in which coarse particles are separated in a cyclone and fine particles in a filter. Isokinetic rate is adjusted by a null-nozzle. *(Original not consulted.)*

106 KRAYUSHKIN, I.F. and MAZUROV, D.Y., Automatic determination of the dust content of flue gases from rotary kilns. Tsement. (4), 24 (1955) (Russian). [Fuel Abstr. 19, 3659 (1956)] *(Original not consulted.)*

107 KUSIAN, R.N., Instrumentation in industrial hygiene and air pollution development at environmental research laboratory - Part II, Stack sampling equipment. The Trend in Engineering, University of Washington, 7, 5-9 (Jan. 1955). [Fuel Abstr. 19, 3658 (1956)]

The development of a portable stack sampling unit is described. *(Original not consulted.)*

108 MOORE, C.B., DOYLE, A.W. and SUPRENANT, N.F., Progress report on A.G.A. research project PF-15. Development of analytical techniques for suspensoids in fuel gas. Proc. Amer. Gas. Ass. 37, 972-1000 (1955). [Fuel Abstr. 22, 2964 (1957)]

The works of the American Gas Association on the investigation of methods for studying concentration, particle size distribution and chemical composition of suspensoids in gases is discussed. Equipment used includes filters, thermal precipitators, cascade impactors, and electrostatic precipitators. A table of types of instruments suitable for securing information on suspensoids is included.

109 MELLOR, D. and STEVENS, P.G., Use of the venturi scrubber on alkali fume. Aust. Pulp. Pap. Ind. Tech. Ass. Proc. 9, 222-48 (1955). [Chem. Abstr. 51, 713b (1957)]

The sampling and testing methods used in determining scrubbing efficiency and dust loading of flue gases from paper mill are described. *(Original not consulted.)*

110 MUSCHELKNAUTZ, E., Correction of the effective pressure indication at nozzles and orifices during quantity measurements of a dust-laden gas stream. V.D.I.-Berichte 6, 55-6 (1955) (German). *(Original not consulted.)*

111 ROUNDS, G.L. and MATOI, H.J., Electrostatic sampler for dust-laden gases. Anal. Chem. 27, (5), 829-30 (1955). [Chem. Abstr. 49, 9334g (1955). Engineering Index 274 (1955). Fuel Abstr. 18, 3638 (1955)].

The device described is claimed to have a higher collection efficiency than conventional electrostatic samplers.

112 ROSINSKI, J. and LIEBERMAN, A., Automatic isokinetic sampling. Appl. Sci. Res. Sect. A. 6, (2-3), 92-6 (1956). [Engineering Index 285 (1956)]

A device is described for sampling airborne particulates isokinetically.

113 SHAW, W.F.B., Measurement of smoke. Coal Merchant and Shipper 110, 473-6 (1955). [Fuel Abstr. 18, 5633 (1955)]

General review of problem of smoke measurement, including a brief discussion of the measurement of smoke inside industrial and domestic chimneys with reference to investigation carried out at the Fuel Research Station in Great Britain. *(Original not consulted.)*

114 **SILVERMAN, L. and DAVIDSON, R.A.**, Electric furnace ferrosilicon fume collection. Trans. AIME 203, 1327-35 (1955). J. Air Pollut. Contr. Ass. 6, (1), 21-8, 48 (1956). [Chem. Abstr. 50, 9181h, 1496c (1956)]

This paper summarises the results of a study of the performance characteristics of a wet and of a dry collection unit. A description of the sampling positions and of the sampling apparatus used is given.

115 **STREDA, I.**, Methods of measuring the ash content of smoke. Strojirenstvi 5, 381-5 (1955) (Czech). [Fuel Abstr. 19, 3660 (1956)] *(Original not consulted.)*

116 **THIBAUT, C.G., SANNA, D. and DOUEZ, F.**, Contribution to the methods for the determination of the dust content of blast furnace gases. Rev. Met. (Paris) 52, (6), 485-507 (1955) (French). [Chem. Abstr. 49, 15629a (1955). Engineering Index 273 (1955). Fuel Abstr. 19, 1868 (1956)]

Dust sampling probes equipped with null nozzles are described; errors caused by anisokineticity and yaw are discussed; examples of calculations are given.

117 **VEREIN DEUTSCHER INGENIEURE**, Technical measurements on dust systems. Vorträge der VDI-Tagung Augsburg 1955. (VDI Berichte, Vol. 7) 1955, 82 pp, VDI-Verlag G.m.b.H., Düsseldorf, Germany. (German)

Contains the following papers.

> **NOSS, E.**, Instruments for the determination of dust content in in flowing gases. p. 5-10.
>
> Abs. in Staub 16, (43), 70 (1956) (German). [Fuel Abstr. 20, 1604 (1955)]
>
> Describes the development of null point nozzle for sampling dust in flowing gases.
>
> **MUHLRAD, W.**, A new sampling probe for measuring dust concentration in flowing gases. p. 11-16.
>
> **NAGEL, R.**, Influence of measurement errors on determination of rate of dust collection. p. 17-23. *(Original not consulted.)*

118 WALTER, E., New sampling probe for determining the dust content in flowing gases. Staub 15, (42), 678-83 (1955) (German). [Fuel Abstr. 19, 5406 (1956)]

Discusses the conditions required for sampling in moving gases, and describes a cyclone probe which can be used either in a vertical or horizontal position. *(Original not consulted.)*

119 WESTLIN, K. and CZERWONKA, L.J., Sampling and analysis of industrial process dust. Amer. Ind. Hyg. Ass. Quart. 16, 283-292 (1955). Abs. in Ind. Hyg. Dig. 20, 29 (Feb. 1956). [Fuel Abstr. 20, 753 (1956)]

This article describes a technique devised to overcome the shortcomings of the various conventional field sampling methods. It is especially applicable where analysis of the character of sub sieve size dust particles in hot or moist gases is involved.

120 WILCOX, J.D., Isokinetic flow and sampling. Paper presented at the Conference on Physics of Cloud and Precipitation Particles, Woods Hole, Mass., (Sept. 7-10, 1955). J. Air Pollut. Contr. Ass. 5, (4), 226 (1956). [Chem. Abstr. 50, 5203h (1956). Fuel Abstr. 20, 750 (1956)]

Errors associated with dust sampling in gas streams are reviewed.

1956

121 MAGILL, P.L., HOLDEN, F.R. and ACKLEY, C. (Editors), Air pollution handbook. McGraw Hill Book Co., New York, 15 Sections separately paginated (1956).

Section 10 by CADLE, R.D., MAGILL, P.L., NICHOL, A.A., EHRMANTRAUT, H.C. and NEWELL, G.W., discusses sampling procedures and equipment. Several probes, nozzles and filter elements are illustrated and described.

122 FEIFEL, E. and PROCHAZKA, R., Electrostatic precipitator. Ger. Pat. 929.990 (March 8, 1956). [Chem. Abstr. 52, 17831 (1958)] *(Original not consulted.)*

123 GRANVILLE, R.A. and BALL, P., Sampling dust and fume-laden gases in ducts or chimneys. B.I.S.R.A. Report No. P/3/56.

Gives full experimental procedure, with details and examples of sampling with B.I.S.R.A. probe. *(Original not consulted.)*

124 GUTHMANN, K., The measurement of dust content in industrial gases. Arch. Tech. Mes. Ind. Messtech. 1286 (1956) (German). *(Original not consulted.)*

125 KANTER, C.V., LUNCHE, R.G. and FUDURICH, A.P., Techniques for testing air contaminants from combustion sources. Proc. Air Pollut. Contr. Ass. 49, Paper No. 25, 33 pp, (1956). J. Air Pollut. Contr. Ass. 6, 191-9 (1957). [Fuel Abstr. 20, 4951 (1956). Chem. Abstr. 51, 3889h (1957)]

Methods used in testing combustion sources such as incinerators and boilers are discussed, including measurements of stack gas velocity, and collection and analysis of particulates. Examples of calculations are given.

126 SOLNIK, R.L., Sampling particulate matter in high pressure gas streams. Paper to Amer. Soc. Mech. Engrs. Petroleum Mechanical Conference (1956). Oil Gas J. 54, 120-4 (Oct. 15, 1956). [Fuel Abstr. 22, 2130 (1957)]

The method describes uses a sampling train consisting of a null nozzle and filter. *(Original not consulted.)*

127 TROYANKIN, Y.V., Determination of dust in flue gases of industrial furnaces. Tr. Mosk. Energ. Inst. (28), 131-46 (1956) (Russian). Abs. in Ref. Zh. Met. (1957) No. 18658 (Russian). [Fuel Abstr. 23, 3663 (1958). Chem. Abstr. 54, 6443d (1960)]

A dry dust collecting apparatus used for measuring the dust content of flue gases from open hearth furnaces is described. *(Original not consulted.)*

128 YAFFE, C.D., BYERS, D.F. and HOSEY, A.D. (Editors), Encyclopedia of instrumentation for industrial hygiene. University of Michigan, Ann Arbor, Michigan, 1234 pp, (1956). [Fuel Abstr. 20, 4150 (1956)]

Gives an extensive list of companies manufacturing sampling equipment with many technical papers and advertisements. *(Original not consulted.)*

1957

129 AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Determining dust concentration in a gas stream. ASME Power Test Code No. 27, 25 pp New York, N.Y., 1957. [Fuel Abstr. 24, 1882 (1958)]

Code is designed to cover tests on any gas stream confined in a duct and carrying particles one micron and larger. Location and number of sampling points is given. Number and duration of runs is mentioned. Sampling equipment and technique is described in detail.

130 Anon, Sampling stack effluents in the Louisville, Kentucky, area. U.S. Bureau of Mines, Annual Report for Fiscal Year 1956, Washington Government Printing, p 19-23 (1956). [Fuel Abstr. 22, 191 (1957)]

A report of determinations of gas flow, temperature, moisture, carbon dioxide, sulphur dioxide, sulphur trioxide, dust concentration and particle size made on the main, coke dryer, pilot plant, and electric furnace stacks of the National Carbide Co. plant at Louisville, Kentucky. *(Original not consulted.)*

131 BARTH, W., NAGEL, R. and VAN WAVEREN, K., New method for the determination of material quantities moved in the air stream of pneumatic conveyors. Chem. Ing. Tech. 29, (9), 599-602 (1957) (German).

Measurement based on change of momentum of fluid-particulate mixture in venturi.

132 BURKE, E., MURRAY, J.J.L. and JOHNSON, K.R., Practical aspects of dust control in the cement industry. Proc. Conf. Mech. Engrs. Contrib. Clean Air, London p 103-17 (1957). Abs. in Smokeless Air, 27, 179 (Spring 1957). Fuel Abstr. 22, 831 (1957). [Chem. Abstr. 53, 3646f (1959)]

A detailed description is given of the Alundum dust sampling apparatus used for determining dust concentrations in cement-kiln gases and the efficiency of dust collecting equipment. *(Original not consulted.)*

133 DENNIS, R., SAMPLES, W.R., ANDERSON, D.M.A. and SILVERMAN, L., Isokinetic sampling probes. Ind. Eng. Chem. 49, (2), 294-302 (1957). [Chem. Abstr. 51, 5469d (1957)]

The aerodynamic characteristics of five specially designed sampling probes were investigated in conjunction with study of isokinetic sampling methods and their relationship to correct representation of concentrations in high velocity gas streams.

134 DORLEYN, M., Instruments for measuring the dust content of cleaned gases after dust extraction plant. Zem.-Kalk-Gips. 10, (4), 128-30 (1957) (German, Eng. Abs.). [Engineering Index 293 (1957)]

Optical instrument is described which operates on the measurement of light scattering. A sampling probe fitted with an external cyclone is also shown.

135 FEIFEL, E., Dust as a charge carrier. Radex Rundsch. 7, 904-17 (1957) (German, Eng. Abs.).

Dust coming into contact with a condenser becomes electrically charged. When measured, this charge gives an indication of the amount of dust present. This article deals with the influence of the particle size on the electric capacity of the dust.

136 FEIFEL, E. and PROCHAZKA, R., Two stage precipitator with contact electric supercharging equipment. Ger. Pat. 1.007.296 (May 2, 1957) [Chem. Abstr. 54, 12846f (1960)]

This article describes an apparatus in which suspended particles in flowing gases or vapours are charged electrically by bringing them into contact with the walls of insulated charging tubes. Under the influence of coulombic and adhesive forces the particles are precipitated subsequently on plates which alternately are grounded or insulated.

137 GALLAER, C.A., How to measure dust in stacks and ducts. Power 101, (1), 88-91 (1957). [Engineering Index 293 (1957). Fuel Abstr. 21, 4682 (1957)]

Describes briefly methods used in measuring volume, temperature and pressure of the gas stream as well as concentration of solid particles as used by Buell Engineering Co. *(Original not consulted.)*

138 GAST, T.H., Determination of solids in exhaust gases by means of an electric microscale. Chem. Ing. Tech. 29, (4), 262-6 (1957) (German). [Chem. Abstr. 51, 9225a (1957). Fuel Abstr. 22, 3124 (1957)]

A gravimetric recording micro balance and its application to the measurement of solids in hot waste gases is described.

139 HEMEON, W.C.L., Dust particle inertia and various consequences. Heat. Piping Air Cond. 29, (2) 247-50 (Feb. 1957). [Engineering Index 292 (1957)]

Importance of determinations of dust particle distribution; calculation of magnitude of particle inertia; relation of particle inertia to dust control, flue dust measurement, particle size determination and to dust collector performance.

140 JACKSON, R. and GRANVILLE, R.A., Measurement of dust in flue gases. Iron and Steel Engineers G.P. Meeting, p 94-103 (1957). Iron Steel Inst. London, Spec. Rep. 61. [Fuel Abstr. 23, 870 (1958)]

Describes trials made at sinter plants and open hearth furnaces using the B.C.U.R.A. and B.I.S.A. sampling probes which showed suitability of both instruments. Tests done on the exit of a producer gas cleaner were not satisfactory because of the high temperature and high tar content of the gases. *(Original not consulted.)*

141 HUBBARD, E.H., Effect of preheated combustion air. J. Inst. Fuel 30, 564-567 (1957). [Chem. Abstr. 52, 691a (1958)]

A high temperature water cooled probe for sampling soot particles isokinetically in oil fired furnaces is described.

142 LITTLE, A.D., Inc., Investigation of sampling procedure requirements. Amer. Gas. Ass., New York (1957). [Fuel Abstr. 24, 3943 (1958)]

The objective of this report is to devise methods for estimating the errors that may be expected in sampling particle-laden gases. These may occur because of anisokinetic sampling, bends in the sampling line, settling of particle, nozzle used. *(Original not consulted.)*

143 RAMMLER, E. and BREITLING, K., Recent developments in fly ash measurements in industrial gases. Chem. Tech. (Leipzig) 9, 636-45 (1957) (German). [Fuel Abstr. 24, 2848 (1958). Chem. Abstr. 52, 15027g (1958)]

The problems associated with dust sampling under normal operating conditions are discussed, and means to improve the accuracy and reduce sources of error are indicated. *(Original not consulted.)*

144 ROSSANO, A.T.,and SCHELL, N.E., Procedures for making an inventory of air pollution emissions. A.P.C.A. Golden Jubilee Meeting, Paper 57-3 (1957). [Chem. Abstr. 52, 20802g (1958)]

Methods used in a special air pollution study of Louisville-Jefferson County, Kentucky, are discussed, including source sampling. Apparatus is illustrated.

145 SHAW, W.F.B., Instruments for measurement of smoke in chimneys. Butterworths Scientific Publications, London, (1957). [Fuel Abstr. 24, 865 (1958)] *(Original not consulted.)*

146 SMITH, J.H. and ROUNDS, G.L., Method of testing open hearth precipitators. Iron Steel Eng. 34, 139-41 (1957).

Gives details of sampling probe, and of method used. *(Original not consulted.)*

147 SOLBACH, W. for MASCHINENFABRIK BETH., Apparatus for determination of dust in gases. German Pat. 1.014.347 (Aug. 22, 1957). [Chem. Abstr. 54, 16949f (1960)] *(Original not consulted.)*

148 TOHATA, H., New type of continuous dust meter. Ryusan 10, 179-83 (1957) (Japanese). [Chem. Abstr. 54, 2828c (1960)]

Tests on a meter for the measurement of dust in the exit gas of a sulphuric acid manufacturing plant are described. *(Original not consulted.)*

149 WALTER, E., Sampling probes and nozzles for the determination of dust content in flowing gases. Staub 17, 880-90 (1957) (German). [Fuel Abstr. 23, 4632 (1958)]

Flow profiles around sampling nozzles were studied using models. It was observed that a pressure ridge was formed upstream when at isokinetic velocity. It is suggested that sampling be done at rates higher than isokinetic velocity, and experiments confirmed that it produced more accurate results.

1958

150 Anon, Determination of smoke dust concentration. Netsu Kanri 10, (3), 18-20 (1958) (Japanese). [Chem. Abstr. 53, 18439a (1959)]

General survey. *(Original not consulted.)*

151 Anon, Dust sampling : isokinetic sampling apparatus. Engineering (London) 186, 230 (1958).

The dust sampling probe "LISA" developed by the British Iron and Steel Research Association is illustrated and described briefly. It is designed to operate up to 650°C.

152 Anon, Measurement of dust concentration in gases. Engineer 205, 864 (1958).

The dust sampling probe developed by the British Iron and Steel Research Association is illustrated and briefly described. It is primarily intended for sampling iron oxide in hot waste gases from steelworks.

153 Anon, Sampling dust and fumes. Mech. World 138, 366 (Aug. 1958). [Fuel Abstr. 24, 5721 (1958)]

The dust sampling apparatus developed by the British Iron and Steel Research Association is illustrated and described. It is intended for sampling waste gases containing iron oxide fumes from steel making processes. *(Original not consulted.)*

154 Anon, Sampling of dust and fume. Iron Steel (London) 31, 344-5 (1958).

The dust sampling probe "LISA" is described briefly. *(Original not consulted.)*

155 BRINK, A.J., Jnr., Cascade impactor for adiabatic measurements. Ind. Eng. Chem. 50, 645-8 (April 1958).

Data is given on the development, design and use of an instrument for the measurement of stack discharges of aerosols.

156 HARRIS, F.J., Gaseous effluents from granulation plants. Proc. Fert. Soc. (49), 56 pp (1958). [Chem. Abstr. 52, 15806b (1958)]

Brief description of sampling method and equipment is given.

157 HAWKSLEY, P.G.W., BADZIOCH, S., and BLACKETT, J.H., Improved sampling equipment for solids in flue gases. J. Inst. Fuel 31, 147-60; 32, 112-19 (1958-59). [Chem. Abstr. 52, 9564d (1958). Engineering Index 435 (1958); 482 (1959). Fuel Abstr. 24, 1870 (1958)]

A sampling probe developed by the British Coal Utilisation Research Association and suitable for the separate determination of grit, dust and smoke concentrations in flue gas is described.

158 IBING, R. and MEIER, G., Calibration and development of dust collecting probes. Research Report of the Ministry of Economy and Commerce of Nordrhein-Westfalen, No. 474 (1958) 20 pp. (German).

Describes the development and testing of null sampling nozzles. The errors due to yaw and anisokinetic sampling are reported.

159 IZMAILOV, G.A., Device for continuous determination of the dust content of gases. U.S.S.R. Pat. 113.558 (1958). [Chem. Abstr. 53, 5776a (1959)]

The apparatus comprises a tube of insulating material equipped with electrodes for forming an a.c. corona. *(Original not consulted.)*

160 JACKSON, R., Measurement of smoke and grit emission. Sanitarian (London) 66, 449-54 (1958). [Fuel Abstr. 24, 5653 (1958)]

A review of the work of the British Coal Utilisation Research Association. *(Original not consulted.)*

161 ROBERT BOSCH, G.m.b.H., Apparatus for determining the dust content of gas streams especially for determining the soot content in the exhaust gases from diesel engines. Ger. Pat. 1.032.005 (June 12, 1958). [Chem. Abstr. 54, 25713 (1960)] *(Original not consulted.)*

162 SEPTIER, L. and LEROY, P., Purifying steel mill smokes. Publ. Inst. Rech. Siderur. Ser. A. (194), 44 pp (1958). [Chem. Abstr. 53, 22643d (1959)]

Techniques for measuring dust concentration in smoke are appended. *(Original not consulted.)*

163 THOMAS, J.W., Gravity settling of particles in a horizontal tube. J. Air Pollut. Contr. Ass. 8, 32-4 (May 1958). [Chem. Abstr. 52, 12284f (1958)]

Presents calculations showing how to establish the fraction of particles entering that leave a horizontal circular tube as function of tube and particle parameters, when sampling smoke and dust from incinerators, boiler stacks, etc.

164 THOMAS, J.W., Sampler for particles in wet gas streams. Chem. Eng. (New York), 65, (3), 148-9 (1958).

Describes briefly the use of a diffusion tube to dry sampled gas stream and prevent moisture condensation in sampling line and filter.

165 VARSHAVSKII, T.P., KOGAN, L.A., LEVIN, E.D. and SHEVCHENKO, N.S., An apparatus for determining the concentration of dust in coke oven gas. Koks. Khim. (8), 18-20 (1958) (Russian). [Chem. Abstr. 52, 20993g (1958)]

The apparatus and filter are illustrated with schematic drawings. *(Original not consulted.)*

166 WALTER, E., Practical limits on gravimetric estimation of dust in flowing gases with special reference to the cyclone probe. Staub 18, 3-4 (1958) (German). [Fuel Abstr. 23, 4633 (1958)]

Explains gravimetric method, and describes procedures of analysis and monitoring.

167 WASSER, R.W., Sampling effluent gases for particulate matter. Amer. Hyg. Ass. J. 19, 469-76 (1958).

Describes procedure and equipment particularly adopted to central station boilers which, with minor modifications may be used to determine particulate matter in any confined gas stream.

1959

168 Anon, Easy way to measure dust or fly ash. Plant and Power Services Eng. 1, 34 (Aug. 1959). *(Original not consulted.)*

169 BADZIOCH, S., Collection of gas borne dust particles by means of an aspirated sampling nozzle. Brit. J. Appl. Phys. 10, (1), 26-32 (Jan. 1959). [Chem. Abstr. 53, 10610c (1959). Engineering Index 335 (1959). Air Pollution Abstr. 02, (03), 82 (1971)]

The efficiency of collection of gas-borne particles by an aspirated sampling nozzle is investigated theoretically and experimentally.

170 BREITLING, K., Improvement of suction stability during flue dust measurements. Staub 19, (3), 79-80 (1959) (German). [Engineering Index 482 (1959)]

Describes a method for the exact adjustment of the suction rate in isokinetic sampling.

171 DOYLE, A.W., SMITH, W.J. and WIEDERHORN, N.M., The collection, monitoring and identification of particles in gas distribution systems. American Gas Association, Inc., New York, 145 pp (1959). *(Original not consulted.)*

172 DUST IN GAS STREAMS.

1 EHRENFELD, J.R., SMITH, N.F., SUPRENANT, N.F. and WIEDERHORN, N.M., The physics of small particles. Amer. Gas. J. 186, (1), 27, 30-3 (1959)

2 MOORE, C.B., EHRENFELD, J.R., and WIEDERHORN, N.M., Instruments for collecting and identifying particles. Amer. Gas. J. 186, (3), 32-4, 36 (1959).

3a DOYLE, A.W., WIEDERHORN, N.M. and SWAN, A., Sampling techniques and errors. Amer. Gas. J. 186, (4), 28-32 (1959). Petrol. Manage. 33, 254-61 (Aug. 1961). [Fuel Abstr. 2, 7709 (1961)]

3b DOYLE, A.W., WIEDERHORN, N.M. and SWAN, A., Recommendations for sampling. Amer. Gas. J. 186, (5), 57-9 (1959). [Chem. Abstr. 53, 15531b (1959)]

4 DOYLE, A.W., EHRENFELD, J.R. and WIEDERHORN, N.M., Theory and operation of the G.A. light scattering photometer. Amer. Gas. J. 186, (7), 27-31 (1959). Petrol. Manage. 34, 258-67 (1962). [Chem. Abstr. 53, 19353c (1959). Fuel Abstr. 3, 7797 (1962)]

Two forward-angle scattering photometers designed to operate at pressures up to 17,5 and 85 kg/cm^2 respectively and monitor suspensoids in gas transmission and distribution systems are described. Their operating principle is reviewed. *(Original not consulted.)*

173 FAITH, W.L., Air pollution control. John Wiley & Sons, New York, 259 pp (1959). [Chem. Abstr. 53, 15433c (1959)]

Sub-chapter, "Sampling in stacks", p 103-119. *(Original not consulted.)*

174 FEIFEL, E., Continuous measurement of dust content of gases. Staub 19, (5), 139-43 (1959) (German, Eng. Abs.). [Chem. Abstr. 55, 25087 (1961). Engineering Index 342 (1960)]

Present dust monitoring methods are examined. Contact electrical measuring method and apparatus are described and first results presented. *(Original not consulted.)*

175 FEIFEL, E. and PROCHAZKA, R., Continuous supervision of dust content in gases by means of recording devices. Tech. Uberwach. 11, 14 (Jan. 1959) (German). *(Original not consulted.)*

176 GAST, T.H., Use of electrical microbalance for the determination of solids carried by hot flue gases. DECHEMA (Deut. Ges. Chem. Apparatewesen) Monog. 31, (426-50), 9-22 (1959) (German). [Chem. Abstr. 54, 9375 (1960). Fuel Abstr. 1, 2392 (1960)]

Apparatus consisting of a small electrostatic precipitator and sensitive self-compensating balance is described. *(Original not consulted.)*

177 GILLI, P., Apparatus for continuous recording of the composition of a two component system. Ger. Pat. 1,070.851 (Dec. 10, 1959). [Chem. Abstr. 55, 17125h (1961)]

One component to be measured may be a gas, liquid or solid, while the other must be a gas. The measurement is done by measuring the heat transfer. The apparatus described is useful for measuring the CO_2, CO and dust content of flue gases. *(Original not consulted.)*

178 GREENE, M., Short cut to stack sampling. Air Eng. 1, 44-5 (Nov. 1959).

A nomograph is given which provides a simplified means for determining size of nozzle to be inserted into the stack as well as adjustable parameters for a given nozzle size. *(Original not consulted.)*

179 GRANVILLE, R.A. and JAFFREY, W.G., Dust and grit in flue gases. Gravimetric sampling of solid particles. Engineering (London) 187, 285-8 (1959). [Engineering Index 482 (1959)]

A description of sampling methods and apparatus is given with special reference to probe developed by the British Iron and Steel Research Association for sampling hot corrosive gases containing micron and submicron fume particles.

180 GROUTSCH, E.R., An automatic dust sampler. Australas. Inst. Mining Met., Proc. (191), 165 (1959). [Engineering Index 482 (1959). Fuel Abstr. 2, 2500 (1961)]

A device is described which is suitable for automatic sampling of dust in flue gases with fluctuating velocity. It consists of two pipes each fitted with a suitably designed venturi, one of which acts as an open ended reference tube and the other as the sampling tube. The sampling rate is automatically controlled so as to maintain a zero pressure differential between the two venturi throats. The venturis are so designed that under these conditions the gas velocity in the sampling tube is always equal to the free gas velocity in the flue, thus maintaining isokinetic sampling conditions.

181 GUTHMANN, K., Measuring the dust content of industrial gases and the air measurements of dust on the ground. Stahl. Eisen 79, (16), 1129-41 (1959) (German). BCIRA (Brit. Cast Iron Res. Ass.) J. 8, (6), 883-902 (1960). [Engineering Index 336 (1959). Fuel Abstr. 1, 371 (1960), 2, 503 (1961)]

The principal instruments for measuring dust are described and a report is given of experience in measuring the dust content of industrial gases and atmospheric air.

182 HARVEY, R.A., A stack gas radioisotope monitor. U.S. At. Energy Comm. HW-56151 REV, 36 pp. (1959). Inst. of Radio Engrs. - Trans. on Nuclear Science, NS-6, (4), 20-8 (Dec. 1959). [Chem. Abstr. 54, 5274g (1960)]

A system for simultaneously measuring and indicating each of several different radioisotopes in the stack effluent of an atomic energy facility is described.

183 HENDRICKSON, E.R., Air pollution sampling and analysis with special reference to sulphate pulping operation. Tappi 42, (5), 173A-176A (1959) [Chem. Abstr. 53, 17392i (1959)]

In the method described, gaseous effluents are drawn through a sampling probe and the particulates are collected on a paper thimble mounted inside the duct. The selection of sampling points is discussed.

184 IZMAILOV, G.A., An apparatus for continuous measurements of particulate matter (dust) in gases. Priborostroenie 7, 16-8 (1959) (Russian). [Chem. Abstr. 54, 23465g (1960)]

The continuous measurement of the dustiness of gases is based on the measurement of the value of an electrical charge induced in the particulate matter under a certain set of conditions. The instrument is recommended for blast furnace gas. *(Original not consulted.)*

185 JACKSON, R., Measurement of grit emission. Steam Eng. 28, (334), 368-74 (1959). [Engineering Index 491 (1960)]

Methods of measurement and properties of grit and dust smokestack emissions; description of dust sampling equipment and comparison of results obtained with two different type; disagreement over methods of dust sampling and methods of interpretation among different investigators cited; recommendations for sampling to achieve uniform results.

186 MATOUSCHEK, F., Gas and dust measurements. Radex Rundsch. 665-72 (Oct. 1959) (German). Abs. in J. Iron Steel Inst. (London) 195, 105 (May 1960). [Fuel Abstr. 1, 2965 (1960)]

The advantages and disadvantages of BEWAG cyclone probe, and the relative error of other sampling techniques are reported and discussed. *(Original not consulted.)*

187 PIETRZYK, Z., Measurement of the dust concentration by the use of isotopes. Chemik 12, 89-91 (1959) (Polish). Biul. Osrodka Poniar'ow i Automatyki (Ministerstwa Przemyski Chem.) 2, 89-91 (1959) (Polish) [Chem. Abstr. 53, 13551f (1959)]

A method is given for the measurement of dust concentration in gases conveyed by pipeline, based on the absorption of beta-rays by dust. *(Original not consulted.)*

188 POHLMAN, R. and WOLTERS, K., Measurement of aerosol concentration by determination of high frequency sound extinction. Chem.-Ing. Tech. 31, (1), 58 (Jan 19 9). Reviewed by Mitchell, R.E. and Engdahl, R.B., J. Air Pollut. Contr. Ass. 13, (11), 562 (1963).

In the instrument described the dust concentration is measured using an ultrasonic extinction method. Extremely high frequencies are used to prevent coagulation of particles. The instrument could be modified to determine particle size as well. No experimental data have been obtained.

189 QUACK, R., Measuring dust concentration in pneumatic conveying. Brennst. Waerme-Kraft. 11, 13 (1959) (German).

Method described is based on attenuation of beta-radiation by concentration of particles passing between emitting source and point of measurement.

190 WHITELEY, A.B. and REED, L.E., The effect of probe shape on the accuracy of sampling flue gases for dust content. J. Inst. Fuel 32, 316-20 (1959).

Describes tests carried out at the Fuel Research Station in order to develop probes for dust sampling that would be more robust and compact than those normally employed. The effect of bluntness of the nozzle and of the length of the neck of the probes on sampling accuracy was investigated.

1960

191 Anon, Grit and dust sampling equipment. Eng. Boiler House Rev. 75, (2), 51-3 (1960). [Engineering Index 579 (1961). Fuel Abstr. 1, 1048 (1960)]

Cyclone unit from multicyclone supplied by Mancuna Engineering Ltd. is used in conjunction with a textile sleeve filter in a sampling train having a minimum gas sampling rate of 85 ft^3/min, thus demonstrating the efficiency of the cyclone on the dust being sampled.

192 Anon, Grit and dust sampling equipment. Engineer 209, 108 (1960).

Mancuna sampling method is described (see Ref. 192).

193 Anon, Measuring dust burdens in gases electrostatically. Engineering (London) 190, 563 (1960). [Fuel Abstr. 2, 1233 (1961)]

An instrument, developed by Associated Electrical Industries, is described in which the particles in the gas are made to acquire an electrical charge proportional to their surface area. The charge acquired is subsequently measured, giving an indication of the total surface sampled, and of the weight of dust if the average particle size and density are known.

194 BADZIOCH, S., Correction for anisokinetic sampling of gas borne dust particles. J. Inst. Fuel 33, 106-10 (1960). [Chem. Abstr. 54, 11588b (1960). Engineering Index 491 (1960). Fuel Abstr. 1, 369 (1960)]

An expression is given for the effect of anisokinetic sampling upon the relative quantity of dust entering the sampling nozzle. Two methods of calculating the dust concentration are considered and a criterion is provided for deciding, under the particular sampling conditions, which method gives the closer approximation to the true dust concentration.

195 BREITLING, K., The beta method; a new stack sampling procedure. Staub 20, (10), 364-5 (1960) (German). [Engineering Index 581 (1961)]

To overcome the sampling difficulties due to stack load variations, a system of multiple sampling and velocity measurements is discussed which will under certain circumstances be effective.

196 ENGEL, L., The measurement of the dust content of waste gases with the Konitest. I.C.E.-Berichte 14-21 (1960). *(Original not consulted.)*

197 GAST, T., Dust measuring equipment indicating or recording weight. Staub 20, (8), 266-72 (1960). [Chem. Abstr. 55, 25112i (1961). Engineering Index 400 (1961)]

The mode of operation and construction of the electronic balance is described, and their possibilities and limitations indicated. The electrostatic precipitator and the maintenance of isokineticity are discussed.

198 GAST, T., Recorded weighings in the milligram range and their application in the measurement of dust. DECHEMA (Deut. Ges. Chem. Apparatewesen) Monog. 38, 1-19 (1960) (German, Eng. Abs.). [Fuel Abstr. 2, 2494 (1961)]

A description is given of the use of the electric micro balance for the gravimetric determination of the concentration of dust in the open air and in effluent gases. *(Original not consulted.)*

199 GRINDELL, D.H., An electrostatic dust monitor. Proc. Inst. Elec. Eng. Part A 107, 353-65, 109, 124-5 (1960). Reviewed by Mitchell, R.E. and Engdahl, R.B., J. Air Pollut. Contr. Ass. 13, (11), 63 (1963). [Engineering Index 491 (1960). Fuel Abstr. 1, 3605 (1960)]

Prototype equipment for pulverised fuel fired boiler installation, theory of which is based on principle that smoke or dust particle carried by air stream and subjected to high voltage corona acquires charge approximately proportional to collector electrode; resultant flow of charge constitutes current proportional to rate of deposition of total dust survace, this constitutes significant measure of toxicity of chimney discharge.

200 HASENCLEVER, D. and SIEGMANN, H.C., New method of dust measurement by means of small-ion deposition. Staub 20, (7), 212-18 (1960) (German, Eng. Abs.). [Engineering Index 400 (1961). Fuel Abstr. 2, 1906 (1961)]

Dust laden gas or air is partially ionized during passage through cylindrical ionization chamber. Reference ionization current I_o for dust free air, and reduced ionization current I_{dust} for dust laden air, enable determination of dust concentration, which is proportional to logarithm of I_o/I_{dust} ratio.

201 HÜBEL, E., Measurement of coal dust flows. Mitt. Ver. Grosskesselbesitzer 67, 230-42 (1960) (German). *(Original not consulted.)*

202 JACKSON, R., Measurement and alleviation of air pollution. Trans. Inst. Eng. in Charge 66, 99-134 (1960)

Describes briefly the technique of sampling coal fired boiler stack emission. The B.C.U.R.A. probe is illustrated.

203 LEES, B. and MORLEY, M.C., Dust sampling provides pollution control. Paper to Nat. Soc. Clean Air Annual Conference Harrowgate (1960). Abs. in Smokeless Air 31, (116), 144 (1960) [Fuel Abstr. 2, 504, 1218 (1961)]

Describes a sampler for routine assessment of dust and grit emitted from boilers and other industrial plants. *(Original not consulted.)*

204 LEES, B. and MORLEY, M.C., Routine sampler for detecting variations in the emission of dust and grit. J. Inst. Fuel 33, 90-5 (1960). [Chem. Abstr. 54, 8159 (1960). Engineering Index 34 (1960). Fuel Abstr. 1, 506 (1960)]

A simple routine sampler is described for determining the grit burden carried in the gas stream after grit arrestors. It consists of a metal cylinder open at one end. Momentum carries the grit and dust particles into the cylinder. (See Ref. 204.)

205 LUPTON, H.P., Industrial gas engineering. Published for the North Western Gas Board by Walter King Ltd., London, England, 392 pp, 1960.

Chapter on flue gas sampling and analysis p 181-82. *(Original not consulted.)*

206 McCUTCHEN, G.D., A comparison of NAPCA and II A source sampling methods. Presented at Meeting of the Amer. Soc. of Mech. Eng. Incinerator Division, Sept. 30, 1960. Preprint, Amer. Soc. of Mech. Eng., New York, 12 p 1970. [Air Pollut. Abstr. 2, (3), 64 (1971)]

Tests involving simultaneous measurements of particulate emissions from a multiple chamber retort incinerator using the II A-6 sampling train developed by the Incinerator Institution of America and the National Air Pollution Control Administration train are reported and discussed. *(Original not consulted.)*

207 NOSS, P., Dust concentration measurements. Staub 20, 243-4 (1960) (German). [Chem. Abstr. 55, 23112i (1961)]

208 WIEMER, P., Isokinetic sampling of dust in flowing gases. Tech. Uberwach. 1, (3), 121-6 (1960) (German). [Fuel Abstr. 1, 1662 (1960)]

The theory of isokinetic sampling is outlined, and the influence of the dust and the shape of the probe on the measurement are discussed. The difficulties encountered in isokinetic sampling and the advantages and disadvantages of thick walled and thin walled probes are described.

1961

209 AMERICAN INDUSTRIAL HYGIENE ASSOCIATION, Air pollution manual. Amer. Industrial Hygiene Association, 14125. Prevost, Detroit, Michigan, 194 pp, 1961. [Fuel Abstr. 2, 8474 (1961)]

Chapter "Stack sampling" p 95-110 includes a review of stack gas sampling methods and equipment. *(Original not consulted.)*

210 Anon, Static charges set up by particles drawn into a new dust meter produce currents varying in relation to dust concentration. Chem. Process (London) 7, (4), 10-11 (April 1961). [Fuel Abstr. 2, 5265 (1961)]

The theory of the "Konitest" dust meter is described. In this instrument the dust laden gas or air on entering is thrown to the outside wall by means of built-in vanes, and the friction between the dust and wall causes both to be charged electrically. The charge taken up by the dust flows past through the earthed outlet duct and is of no further interest. The charge set up in the wall itself, however, is passed through suitable sensitive metering devices before being earthed. *(Original not consulted.)*

211 Anon, Recording flue dust monitor. Instrum. Rev. 8, (113), 727 (May 1971). [Fuel Abstr. 2, 4536 (1961)]

A flue dust monitor produced by Evans Electroselenium Ltd. is described. It consists of a sampling head, a control unit and a recorder unit. The sampling and measuring head is fitted in a duct leading to the chminey and samples the percentage of coarse dust and grit photoelectrically at predetermined intervals, usually of 15 minutes. *(Original not consulted.)*

212 Anon, Dust meter. Instrum. Rev. 8, 79 (Jan. 1961). [Fuel Abstr. 2, 1904 (1961)]

Describes the "Konitest" dust measuring instrument. (See Ref. 211) *(Original not consulted.)*

213 Anon, Equipment for measuring and recording smoke, fumes and dust from chimneys. Chem. Process (London) 7, 59 (Nov. 1961). [Fuel Abstr. 3, 605 (1962)]

Describes the Visco Isokinetic sampling train, and the method used for dust sampling. *(Original not consulted.)*

6

214 **BARKOV, N.N.,** Electronic analyser type EG-59P of the amount of dust in gases. Priborostroenie 3, 23 (March 1961) (Russian). Reviewed by Mitchell, R.I. and Engdahl, R.B. J. Air Pollut. Contr. Ass. 13, (11), 558 (1963).

This instrument is based on a differential measurement of the complex dielectric constant of the tested substance. It consists essentially of a wheatstone bridge arrangement in which the dust laden air passes through a leg and the dirt is removed by a filter; the amount of unbalance is proportional to the dust loading. *(Original not consulted.)*

215 **BATTISTON, M.N.,** Evaluation of quantity of solid particles in flue gases. Thermotecnica 15, 456-71 (Sept. 1961) (Italian). [Chem. Abstr. 56, 5077i (1962). Fuel Abstr. 3, 2027 (1962)]

Describes a method of collecting quantitatively the solid particles carried by flue gases, by passing the gas through a column filled with seignette salt crystals which the heat of the gases maintains at melting point. The number of particles collected is assessed by weight after the salt has been dissolved. *(Original not consulted.)*

216 BRITISH STANDARDS INSTITUTION, Simplified methods for measurement of grit and dust emission from chimneys. British Standard 3405/1961, 76 pp. [Engineering Index 30 (1962). Fuel Abstr. 2, 8493 (1961), 3, 1361 (1962)]

Rules are prescribed for determining, with reasonable degree of accuracy under defined conditions, concentration of grit and dust or total solids in gases and total weight of solids carried in unit time by gases passing through flue or discharged by chimney, apparatus for such determination is recommended.

217 COLLINS, K.E. and STEELE, D.H., High sensitivity recording optical density meter. J. Sci. Instr. 38, 186-90 (May 1961). Reviewed by Mitchell, R.I. and Engdahl, R.B., J. Air Pollut. Contr. Ass. 13, (11), 558-63 (1963). [Engineering Index 579 (1961). Fuel Abstr. 2, 4535 (1961)]

A recording optical smoke meter is described in which the optical density of smoke in a flue is compared by photo electric means with that of an optical wedge which is then rotated by an electrically operated servo system until the two densities are the same. The angular position of the wedge is detected by a transducer, which provides a millivolt output proportional to the rotation of the wedge.

218 CROSSE, P.A.E., LUCAS, D.H. and SNOWSILL, W.L., Instrument for recording the dust nuisance emitted by chimneys. J. Sci. instr. 38, (1), 12-17 (1961). [Fuel Abstr. 2, 1907 (1961)]

Details are given of the construction, principle of operation, testing and practical performance of an instrument designed to collect the amount of dust which would impinge on a surface of unit area placed at right angles to the gas stream and to measure the optical obscuration of the surface produced by this amount of dust.

219 CROSSE, P.A.E., LUCAS, D.H. and SNOWSILL, W.L., The measurement of dust nuisance emitted by chimneys. J. Air Water Pollut. 4, (3, 4), 221-4 (1961). [Engineering Index 400 (1961). Fuel Abstr. 3, 609 (1962)]

Description is given of an instrument to measure the dust emitted from a chimney by optical means.

220 CROSSE, P.A.E., LUCAS, D.H. and SNOWSILL, W.L., The design of an "Everclean Window" for the observation of an optical density of flue gas. J. Inst. Fuel 34, (250), 503-5 (1961). Reviewed by Mitchell, R.I. and Engdahl, R.B., J. Air Pollut. Contr. Ass. 13, (11), 563 (1963). [Fuel Abstr. 2, 7715 (1961). Engineering Index 1280 (1962)]

In the design described, a honeycomb is inserted into a horizontal closed end observation tube, so that drift of aerosols toward the glass covered end is arrested.

221 DIXON, W.S., Selecting proper flue gas probes. ISA J. 8, 42-5 (Dec. 1961). [Engineering Index 476 (1962)]

Reviews briefly general considerations in selecting a flue gas probe and describes fair basic types for specific purposes. *(Original not consulted.)*

222 EDOUARD, L., Measurement of dust content of gases at the inlet of stacks of Creil thermal power station. Génie Civ. 138, (12), 270-6 (June 15, 1961) (French). Translated by Franklin Inst. Research Labs., Philadelphia, Pa., Science Information Services, 29 p, (Oct. 31, 1969). [Engineering Index 399 (1961). Air Pollut. Abstr. 2, (2), 76 (1971)]

Dust collecting facilities of 500 MW plant are described. Control measurements of proportion of dust by weight and volume of discharge gas, before and after dust collectors; description of measuring apparatus; calculations. *(Original not consulted.)*

223 GAST, T., Recording dust concentration measurements. Staub 21, (2), 136-9 (1961) (German). [Chem. Abstr. 55, 17962d (1961)]

A discussion of the different principles used in the measurement and recording of the dust content of gases with particular emphasis on the "Konitest" instrument.

224 HAWKSLEY, P.G.W., BADZIOCH, S. and BLACKETT, J.H., Measurement of dust in flue gases. British Coal Utilisation Research Association, Leatherhead, England, 214 pp, 1961. [Fuel Abstr. 2, 8494 (1961). Chem. Abstr. 57, 2540e (1962)]

This book reports on the experience gained and conclusions reached from an extensive series of investigations into the sampling of solids emitted in waste flue gases from solid-fuel fired plant. It consists of three parts covering different aspects of the subject. Part One describes a procedure for measuring grit and dust, as distinct from total solids, when an accuracy of ± 20 % is adequate. The purpose of Part Two is to provide the engineer with the background information necessary to obtain accurate measurements in determining the mass rate of flow of solids, or of grit, dust and soot separately. Part Three discusses the physics of sampling and the methods of studying the flow of solids through ducts. It contains also the evidence on which the procedures recommended in Part One and Two are based. Part Three is primarily intended for the research investigator.

225 IZMAILOV, G.A., Measuring the gravimetric concentration of dust in the air using beta-radiation. Zavod. Lab. 27, (1), 40-3 (1961) (Russian). Reviewed by Mitchell, R.I. and Engdahl, R.B. J. Air Pollut. Contr. Ass. 13, (11), 558-63 (1963).

This instrument determines the mass of dust collected on a filter by means of radiation techniques. The air stream is monitored continuously by means of a cloth belt. The filter is then passed between a beta-radiation source and a detector. The mass of materials on the filter is directly proportional to the amount of absorption of the beta-rays. If the filtration rate is known, the dust loading can be determined directly. *(Original not consulted.)*

226 IZMAILOV, G.A., Use of radioactive isotopes and nuclear radiations in industry. No. 14. Apparatus for automatic measurement and recording of dust concentration in air by means of beta-radiation. Izdatel. Tsentral. Inst. Tekh. Ekon. Inform., Moscow, 8 pp 1961 (Russian). [Chem. Abstr. 55, 21903 (1961)] *(Original not consulted.)*

227 KÖNIG, W. and ROCK, H., Effect of temperature and gas flow rate on the electrostatic duct measuring apparatus "Konitest". Staub 21, (8), 355-7 (1961) (German). [Chem. Abstr. 55, 26561f (1961). Fuel Abstr. 2, 6329 (1961)]

The "Konitest" electrostatic dust sampler was tested in the laboratory with lycopodium spores at various temperatures and gas flow rates. Temperature variations affect the sampling rates and special precautions for balancing the flow must be taken.

228 MAKSIMOV, V.F. and BUSHMELEV, V.A., A method for determining moisture content and dust content of gases. Nacuh.-Tekh. Inform. Tsent. Inst. Nauch.-Tekh. Inform. Bum. Derevoobrab. Prom. Tsellyul.-Bum., Gidroliz. Lesokhim. Prom. (10), 3519 (1961) (Russian). [Chem. Abstr. 58, 2774h (1963)]

Review of the theoretical basis of a simplified method for determining the moisture and dust content of gases. An apparatus for taking gas samples is described and formulas are given for calculating the moisture and dust content.

229 MOORE, C.B., EHRENFELD, J.R. and WIEDERHORN, N.M., Dust in gas streams. Petro./Chem. Eng. 33, (7), D15 (1961). [Fuel Abstr. 3, 608 (1962)]

This paper reviews instruments for monitoring dust laden gas streams such as light scattering meters, electrostatic counters, electrostatic surface area meters, and hot wire evaporators for mists; and also particle collection devices including various types of filters, sedimentation and impaction devices, cyclones and electrostatic precipitators. *(Original not consulted.)*

230 NOSS, P., SCHILLER, A. and WIEMER, P., Investigating a sampling probe for measuring the dust concentration in flowing gases. Research Report of the State of Nordrhein-Westfalen, No. 1041. Westdeutscherverlag 24 pp, (1961) (German)

Describes sampling tests done with a probe having nozzles of three diameters.

231 SCHWENDIMANN, L. and POSTMA, A.K., Turbulent deposition in sampling lines. 7th Atomic Energy Commission Air Cleaning Conference (1961) USAEC, TID-7627, Book 1, p 127. *(Original not consulted.)*

232 SOLBACH, W., Measurement of dust content and collecting efficiency. Wasser, Luft. Betr. 5, (12), 509-18 (1961) (German). [Fuel Abstr. 3, 1376 (1962)]

Describes equipment and procedures used in measurement of dust content of flowing gases. *(Original not consulted.)*

233 STEIN, J., TAYLOR, B.G.S. and WADE, G.R., Techniques employed in a study of the properties of flue gases from large oil-fired boilers. J. Inst. Fuel 34, 8-16 (1961). [Chem. Abstr. 55, 7804g (1961)]

Dust sampling probe used by ESSO is described. Probes of different lengths are used so that traverses can be made across stacks of various sizes. Filter consists of a light stainless steel mesh cage into which is inserted a glass wool thimble.

234 STEPHENS, J.F., A practical stack sampling procedure. Amer. Ind. Hyg. Ass. J. 22, 377-84 (1961). [Chem. Abstr. 55, 27722f (1961). Fuel Abstr. 3, 1986 (1962)]

Stack sampling procedure applicable to most field conditions is described. Metering, sampling and analytical variations provide the versatility needed. Several tables are suggested as field work aids to the engineer. Particulate loading of filters, mass emission rates, collection efficiencies and calibrations are discussed.

235 WEBER, H.J. (Chairman) COMMITTEE T1-7, Air pollution problems of the foundry industry. Informative report No. 4. Instruments and techniques for measuring foundry air pollution emissions. J. Air Pollut. Contr. Ass. 11, (4), 166-8 (1961).

Problems of sampling particulate emissions from foundry cupolas are discussed. General aspects of sampling, location of sampling, measurement of velocity and temperature, filters, maintenance of isokinetic rate. Description of actual sampling test on cupola.

236 WOLFE, E.A., Gas flow rate and particulate matter determination of gaseous effluents. Issued by the Bay Area Pollution Control District, 1480 Mission Street, San Franciso 3, California, 44 pp, Revised August 1, 1961. *(Original not consulted.)*

1962

237 Anon, Committee for dust technology. Dust concentration measurements in cement works. Verein Deutscher Zementwerke V. Merkblatt St. 4 (1962) (German). *(Original not consulted.)*

238 **FEIFEL, E. and PROCHAZKA, R., Apparatus for measuring the dust content of gases and vapours on stream. Ger. Pat. 1.121.849 (Jan. 11, 1962). Chem. Abstr. 58, 26, (1963).**

The dust in a sample of the flowing gas or vapour is charged electrostatically and the electrical effects of the charged particles on the electrical field in a grounded pipe are determined. The intensity of the effects is a measure of the dust content. *(Original not consulted.)*

239 **GRINDELL, D.H., Monitoring smoke and flue dust emission. AEI (Ass. Elec. Ind.) Eng. 2, (5), 229-35 (Sept.-Oct. 1962). [Engineering Index 1280 (1962). Fuel Abstr. 3, 8488 (1962)]**

Electrostatic dust monitor described measures surface area of dust passing selected point in flue duct in unit time; monitors of this time provide continuous record of dust emission and respond rapidly to sudden changes in dust burden of chimney gases.

240 **HUNT, M. and LAWSON, A.T., The control of dust and fume emissions from an integrated steelworks. Proc. Clean Air Conf., New South Wales, Vol II, Paper 15, p 1-28 (1962). [Chem. Abstr. 58, 12219e (1963)]**

The types of emissions from the main sources and the choice of sampling equipment are discussed. *(Original not consulted.)*

241 MURAKAMI, T., FUKUNAGA, S. and CHIBA, M., Studies on method of measuring dust concentration in gas flow. Nippon Kikai Gakkai Rombunshu. 28, (186), 235-56 (1962) (Japanese, Eng. Abs.). [Engineering Index 37 (1963)]

Discussion on collection efficiency of paper filter and specific resistance of loaded dust; performance of apparatus for measuring pressure increase and construction of apparatus for continuous measurement of dust concentration in air for values between 0,004 and 67,2 g/m^3. *(Original not consulted.)*

242 NAGEL, R. and IBING, R. for MASCHINENFABRIK HARTMANN, Apparatus for continuously sampling and measuring the dust content of air streams. Ger. Pat. 1.126.649 (Mar. 29, 1962). [Chem. Abstr. 58, 872f (1963)] *(Original not consulted.)*

243 **NATIONAL COUNCIL FOR STREAM IMPROVEMENT, Inc., Manual for the sampling and analysis of kraft mill recovery stack gases. National Council for Stream Improvement, Inc., 271 Madison Avenue, New York 16, N.Y., Atmospheric Pollution Technical Bulletin No. 14, 30 pp (October 1962).**

Describes a method for sampling and analysing both particulate and gaseous emissions from kraft mill recovery stack gases. The procedures were developed and tested by the National Council's University of Florida research project. *(Original not consulted.)*

244 **PATTON, W.F. and BRINK, J.A., New Equipment and techniques for sampling chemical process gases. Presented at 55th Annual Meeting of A.P.C.A., Chicago, (May 20-24, 1962). J. Air Pollut. Contr. Ass. 13, (4), 162-6 (1963). [Engineering Index 35 (1963). Fuel Abstr. 4, 6723 (1963).** Air Pollut. Abstr. 2, (2), 94 (1971)]

Portable equipment suitable for routine sampling of particulates in process gases is described. With this apparatus the loading of particles greater than 3 microns is determined separately from smaller particles by using a small cyclone followed by a filter. It can also be used for the determination of mists.

245 PENGELLY, A.E.S., New equipment for flame and furnace research. J. Inst. Fuel 35, (256), 210-19 (1962).

Contains a section on gas and solid sampling. A water cooled head suitable for isokinetic sampling is illustrated.

246 PROCHAZKA, R., A new method of continuous monitoring dust in working areas and industrial plants. Moderne Untfallverhütung (6), 17-28 (1962) (German). *(Original not consulted.)*

247 ROBOK, K., Fundamentals of optical dust measurement. Staub 22, (3), 80-4 (1962) (German). [Fuel Abstr. 3, 5076 (1962)]

The theoretical fundamentals are indicated and discussed for the two basically possible optical methods of dust measurement, namely transmitted and reflected light methods.

248 ROPER, R.W., Flue dust monitor equipment. Chem. Process Eng. 43, (4), 160-1 (1962). [Fuel Abstr. 3, 4353 (1962)]

A continuous monitor to measure pulverised-fuel dust particles passing through precipitator ducts has been developed recently. It is sensitive to dusts and smokes with particle diameters less than 0,1 microns. *(Original not consulted.)*

249 TOYNBEE, P.A. and PARKES, W.J.S., Isokinetic sampler for dust laden gases. Int. J. Air Water Pollut. 6, 113-20 (1962). [Engineering Index 329 (1962). Fuel Abstr. 3, 7200 (1962)]

A probe for sampling dust laden gases is described in which null point adjustment of the differential pressure across the wall of the nozzle is used to ensure isokinetic sampling. Frictional loss inside the nozzle is compensated by a slight expansion of the gas inside the probe.

250 WALTER, E., Continuously operating monitoring instruments for the dust content in still air and moving gases. Staub 22, (4), 162-65 (1962) (German). [Chem. Abstr. 57, 4487c (1962). Fuel Abstr. 3, 5075 (1962)]

A report is given of a number of appliances, including Micromax optical, Konitest, A.E.G. optical and other optical instruments, which offer a choice from both the financial and technical viewpoints.

251 WILSON, A.C., CEGRIT automatic dust sampler. Steam Eng. 31, (369), 394-5 (1962). [Fuel Abstr. 3, 7799 (1962)]

The Central Electricity Generating Board automatic dust sampling equipment is described. It consists essentially of a heated miniature cyclone through which a sample of flue gas is continuously drawn by an ejector device operated by the suction in the flue itself. *(Original not consulted.)*

252 WOLFE, E.A., New way to sample industrial gas streams. Air Eng. 4, (12), 24, 26-29 (1962). [Fuel Abstr. 4, 2632 (1963)]

Results of test using a filter cloth of stainless steel fibres are publicised, and cost is compared to that of alundum thimbles. *(Original not consulted.)*

1963

253 Anon, Monitoring flue dust. Meas. Contr. 2, (1), 16-20 (1963). [Fuel Abstr. 4, 1982, 3622 (1963)]

An optical monitor designed by C.E.R.L. is described, and its application to West Ham power station discussed, and its effectiveness indicated. *(Original not consulted.)*

254 Anon, Monitoring flue dust. Elc. Times. 143, 406-7 (1963). [Fuel Abstr. 4, 4479 (1963)]

This paper discusses optical instruments for monitoring the dust content of flue gases. *(Original not consulted.)*

255 CHAKKO, M.K., Measurement of aerosol concentration in turbulent flows. U.S. Dept. of Defence, Report AD.425172. Syracuse University, New York, 11 pp, 23 diag. (1963).

Use of a hot wire anemometer aerosol counter to study the effect of turbulent and anisokinetic suction on the results of concentration measurements by suction probes is discussed. Experiments showed that turbulence had no effect on the results of concentration measurements using suction probes for the aerosols tested. Correction curves for anisokinetic suction were obtained for three probes.

256 COENEN, W., Dust measuring device for factory dust monitoring. Staub 23, (2), 119-23 (1963) (German). [Fuel Abstr. 4, 3847 (1963)]

A dust measuring device based on the principle of deposition of ions, (See Ref. 201) is described and its lowest level of detection is investigated. It is shown that this lower limit is determined by fluctuating concentrations of condensation nucleii in the measured air flow. The level of detection is given as a function of the density of condensation nucleii and the average size of dust particles.

257 DEVORKIN, H., *et al*, Source testing manual. Los Angeles Air Pollution Control District, Los Angeles, California, 90013, 198 pp (1963). [Fuel Abstr. 8, 517 (1967)]

Theory and practice of source sampling and analytical methods are presented. Topics discussed include planning a source test, determination of gas flow rate, collection and analysis of particulate matter and gaseous constituents and the source test report. A sample source test report, including calculations is appended. *(Original not consulted.)*

258 KAHNWALD, H. and ETTERICH, O., Estimation of flue gas quantity, composition and temperature and dust evolution in the melting and refining with gaseous oxygen in a 15 ton arc furnace. Stahl Eisen 83, (17), 1067-70 (1963) (German). [Chem. Abstr. 60, 1371f (1964)]

Description of the apparatus and preliminary experiments. Reconstruction of the apparatus on the finding of these studies. New experiments and results.

259 KUBALEK, J., Application of the Laval nozzle for measurement of dust concentration. Rudy 11, 342-5 (1963) (Czech). [Chem. Abstr. 60, 11627f (1964)]

The use of the Laval nozzle as a device for measurement of the flow rate of air during determinations of dust concentrations is discussed. A model of an apparatus for gravimetric determination of dust concentrations by using the principle of the Laval nozzle is described. The results of the laboratory and operational tests of this device are discussed. *(Original not consulted.)*

260 MITCHELL, R.I. and ENGDAHL, R.B., A survey for improved methods for the measurement of particulate concentrations in flowing gas streams. J. Air Pollut. Contr. Ass. 13, (11), 558-63 (1963).

Report describes a survey undertaken to uncover promising new techniques for the determination of dust loading in flowing gas streams through a search for literature which may have been published pertinent to this problem within recent years. Six methods are discussed briefly which refer to (1) determination of mass of dust sampled by attenuation of beta radiation, (Ref. 225), (2) measurement of the dielectric constant of the air stream (Ref. 214), (3) Measurement of an electrical charge induced into the particles (Ref. 199), (4) measurement of light transmission through the gas stream (Ref. 59, 217), (5) attenuation of ultrasonic sound waves by the dust in the gas stream (Ref. 188), and (6) measurement by beta-particle attenuation.

261 MOORE, A.S., Sampling dust in Bureau of Mines coal fired gas turbine. Combustion 35, (4), 28-30 (Oct. 1963). [Engineering Index 791 (1963). Fuel Abstr. 4, 7987 (1963). Air Pollut. Abstr. 2, (2), 83 (1971)]

Special equipment and methods employed by Bureau of Mines at its Morgantown, W.Va. Coal Research Center to sample dust in gases driving turbine; features of actuated probe for sampling dust laden gas entering gas turbine in which carriage moves sampling probe and Pitot tube back and forth across stream of dust laden gas.

262 MUELLER, H., Photoelectric measurement of smoke and dust density by a two beam compensation method. Keram. Z. 15, 760-2 (1963) (German). [Fuel Abstr. 5, 7469 (1964)]

Details are given of an indicator (Firma Erwin Sick, Munich, W. Germany) which automatically compensates for variations in light intensity, fouling of the optical surfaces, etc., but not for the light absorption of the dust or smoke itself. *(Original not consulted.)*

263 MÜLLER, H., Photoelectric smoke density apparatus by the two beam compensation method. Staub. 23, (2), 123-5 (1963) (German). [Fuel Abstr. 4, 3845 (1963)]

The development of a smoke meter using a two beam compensation method and the autocollination principle is reported.

264 PRINCEN, L.H. and CLARENBURG, L.A., Device for continuous aerosol sampling. Rev. Sci. Instrum. 34, (7), 742-4 (1963). [Engineering Index 22 (1963)]

A simple apparatus is described by means of which it is possible to branch off between 0,4 and 16 % of an aerosol stream for continuous isokinetic sampling. An easy method of calibration is given.

265 SCHÜTZ, A., Recording monitor for very low dust concentrations following filters. Staub 23, (2), 115-18 (1963) (German). [Fuel Abstr. 4, 3850 (1963)]

First experiments on a very low dust concentration recording monitor are reported which uses a simple electrical contact method. Electric charges occuring when dust particles impinge on a metal wire are measured continuously. A relationship is determined between the value indicated and gravimetrically determined dust concentration for various wire diameters.

1964

266 AVY, A.P. and BENARIE, M., Counting particles with sound impulses. Staub 24, (9), 343-4 (1964) (German). [Chem. Abstr. 62, 8681c (1965). Engineering Index 570 (1965). Fuel Abstr. 6, 585, 2893 (1965)]

A method is described for counting particles by recording voltage impulses as these hit a microphone placed in a partially evacuated (0,1-10 ton) vessel. The particles enter the vessel through a small orifice and hit the microphone with a velocity of several m/s. Particles down to 15 microns size can be counted.

267 BENARIE, M., Instrument for measuring dust concentration. French Pat. No. 1.408.903 (July 9, 1964). *(Original not consulted.)*

268 BRINK, J.A. and PORTHOUSE, J.D., Total sampling techniques for air pollution control. Presented at 57th Meeting Air Pollut. Contr. Ass., Houston, Paper 64-81 pp 13, 8 diag. (1964). [Fuel Abstr. 6, 3684 (1965)]. Reprinted under title : Efficient dust control via new sampling technique. Chem. Eng. (New York) 76, (5), 106-10 (March 10, 1969). [Fuel Abstr. 10, 7469 (1969). Engineering Index 69, (1), 845 (1970)]

Describes a "total sampling" method capable of handling the entire process gas stream and suitable for process equipment of small capacity such as dust hoods for conveyors, crushers, loading station, etc. and pilot scale equipment where dust is produced.

269 BUISSON, M.P., Measurement of dust concentration of smoke from a steam power station by means of an opacimeter. Pollut. Atmos. 5, (18), 79-80 (1963) (French). [Fuel Abstr. 5, 2705 (1964)]

Describes the application of optical density meters to a steam power station. *(Original not consulted.)*

270 CHASICK, A.H. and BOOTES, R.L., Determining the efficiency of air filters. Water Works. Wastes Eng. (Jan. 1964).

Laboratory tests that demonstrate the superiority of fibre glass disc over aluminium oxide and Whatman paper thimbles for evaluating air filter performance are described. Holders for the three types of filters are illustrated.

271 COENEN, W., Recording dust measurements by the small ion deposition technique. Staub 24, (9), 350-3 (1964) (German). [Chem. Abstr. 62, 8681e (1965). Engineering Index 571 (1965). Fuel Abstr. 6, 1980 (1965)]

An instrument is described which operates by the small ion deposition technique (see Ref. 200). The scope and limitations of the method are discussed, as well as the influence of factors such as air pressure, temperature and condensation nucleus diameter.

272 DAVIES, I., WILSON, C. and PAYTON, E.J., Continuous monitoring of dust emission from power stations. Development of new type of monitoring instrument. Electricity 17, 172-3 (May, June 1964). [Fuel Abstr. 5, 6324 (1964)]

A light beam meter in the form of a self contained probe has been developed; it is pre-assembled, tuned up and calibrated before installation, and can easily be withdrawn for checking the zero. It can be used also as a portable test instrument for dust collector tests or emission investigations and, by adjusting its sensitivity, as a conventional smoke meter. The design of the instrument is outlined. *(Original not consulted.)*

273 DRESIA, H., FISCHÖTTER, P. and FELDEN, G., Continuous measurements of dust content in air and waste gases by means of beta-rays. VDI (Ver. Deut. Ing.))Z. 106, (24), 1191-5 (1964) (German). [Engineering Index 570 (1965). Fuel Abstr. 5, 7467 (1964)]

Dust masses which are deposited by means of filter or cyclone can be determined and registered quasi-continuously by measuring attenuation of beta-radiation on dust deposit; apparatus described indicates few milligrams of dust/cm^2 irrespective of grain size and chemical composition of dust, measuring of scattered beta-radiation permits also determination of dust composition provided it can be treated as two component mixture with substantially different numbers of both components.

274 FUCHS, N.R., The mechanics of aerosols. Translation edited by C.N. Davies. The MacMillan Company, New York (1964). Translated by U.S. Army Chemical Warfare Laboratories. C.W.L. Special Publication 4-12 (1958).

Draws attention to the requirements for correctly sampling an aerosol and the need for techniques superior to those now used to accomplish this end. *(Original not consulted.)*

275 GREEN, H.L. and LANE, W.R., Particulate clouds - dusts, smokes and mists. Their physics and physical chemistry and industrial and environmental aspects. D. Van Nostrand, Princeton, N.J., 2nd ed., 471 pp. (1964). [Chem. Abstr. 62, 4654a (1965)]

Errors caused by anisokinetic sampling and yaw are assessed and the results of several workers in this field are summarized.

276 LANGEJAN, J.J.D., Air pollution by fertilizer plants; stack gas sampling. Progress Report No. 5. CSIR (Counc. Sci. Ind. Res., S. Afr.) Contract Report C Chem 58 (1964)

The work on stack gas sampling in Pretoria with the sampling device which evolved from earlier work is discussed. The dust sampling reproducibility was good but the average efficiency of dust sampling was only 93,5%. These figures were established under slightly adverse conditions in the stack. Recommendations are for further work to improve the sampling equipment, the sampling technique and the testing facilities.

277 NARJES, L., Novel zero pressure probes for quasi-isokinetic dust sampling at high dust concentration of the gas flow, Part I and II. Arch. Tech. Mes. Ind. Messtech. (336) 3-6 (337) 33-34 (1964) (German) *(Original not consulted.)*

278 NONHEBEL, G., Gas purification processes. G. Newnes Ltd., London, W.C.2. 894 pp (1964)

The theory of isokinetic sampling is discussed and errors resulting from anisokineticity and yaw are mentioned. Recommendations are made for planning tests, selecting sampling positions, number of sampling points and location of access holes. Selection of sampling equipment for extreme and for low dust concentrations is described. Test procedures and calculations are given.

279 PROCHAZKA, R., Instrument to determine dust concentration in gases. Ger. Pat. 1.181.944 (1964). [Chem. Abstr. 62, 61724 (1965)]

Details are given of a venturi transducer coated with piezoelectric material. *(Original not consulted.)*

280 PROCHAZKA, R., Latest developments with the konitest contact electric dust measuring device. Staub 24, (9), 353-9 (1964) (German) [Engineering Index 570 (1965). Fuel Abstr. 6, 581, 1981 (1965)]

Results with "Konitest" for continuously recording dust concentration in working places is reported; experiment with aerosol generators are described which indicate sensitivity of measuring apparatus to fine particle solid aerosols.

281 RENDLE, L.K., Measurement of flue gas solids burden from oil fired installations using silica wool filter. J. Inst. Fuel 37, (276), 25-30 (1964). [Engineering Index 673 (1964). Fuel Abstr. 5, 549 (1964)]

Method was devised for routine determination of solids burden in flue gases from full scale oil fired installations in field and from pilot-scale rigs in laboratory; method is used when no particle size distribution is required, and is capable of giving reliable results over whole range of operating conditions; silica wool filter does not alter in weight as result of possible reaction with SO_3 and so accurately measures smaller amount of solid material in flue gases from oil fired plant.

282 SEXTON, R.W., Stack sampling of chemical mists and vapours. Amer. Ind. Hyg. Ass. J. 25, (4), 346-53 (1964). [Fuel Abstr. 6, 4504 (1965)]

The use of standard laboratory equipment for determining stack concentrations and collection efficiencies of chemical mists and vapour collectors is described. Apparatus is suitable for sulphuric, hydrochloric, perchloric, acetic, nitric, phosphoric and chromic acids, as well as ammonia, chlorine gas, ethylene diamine and nitrogen oxides.

283 SILVERMAN, L., An automatic monitoring system for stack particulates. Amer. Ind. Hyg. Ass. J. 25, (6), 529-44 (1964). [Fuel Abstr. 6, 4498 (1965). Chem. Abstr. 66, 58652t (1967)]

This study is concerned with development of an automatic weight concentration analyzer. The physical properties, resistance, efficiency and life of layers of solid and hollow glass spheres ranging in size from 30 to 500 microns, are assessed. Size layers of hollow spheres provide a known surface area of low tare for collection; they can be weighed directly and also transported pneumatically. The angle of slide and both horizontal and vertical transport velocities were measured to obtain design factors for a suitable conveying system.

284 SKAGGS, H.C., Fly ash sampling; guide to better combustion. Elec. World. 162, 119-20 (Sept. 21, 1964). *(Original not consulted.)*

285 VITOLS, V., Determination of theoretical collection efficiencies of aspirated particulate matter sampling probes under anisokinetic flow. Ph. D. Thesis, University of Michigan, 244 pp (1964). [Diss. Abstr. 26, (1/2), 327 (1965)]

The purpose of this study was to determine theoretical collection efficiencies of particulate matter sampling probes by means of particle trajectory calculations for various conditions of anisokinetic flow. The immediate significance of this work was (1) to assess the conformance or the idealizations necessary in the theoretical treatment of physical sampling situations, (2) to provide a means for quantitative estimation of anisokinetic sampling errors, and (3) to evaluate the significance of pertinent fluid flow and particle variables. *(Original not consulted.)*

1965

286 Anon, Atmospheric emissions from sulphuric acid manufacturing processes. Public Health Service Publication No. 999-AP-13, U.S. Govt. Printing Office, Washington, D.C., 61 pp (1965).

The sampling and analytical techniques for assessing emissions is presented in detail on page 61-93. The Monsanto Company technique for sampling sulphuric acid mist (see Ref. 244) was used and is described.

287 Anon, Dust sampler. Ind. Process Heat 5, 55 (July 1965). [Fuel Abstr. 6, 7070 (1965)]

An automatic dust sampler made under licence from the Central Electricity Generating Board is described. It consists essentially of a heated cyclone through which flue gas is continuously drawn by an ejector. The detachable glass container receives the dust, enabling the operator to observe the rate of deposition and any changes in colour (see Ref. 251).

288 BODIN, D., Continuous sampling instruments for emission control. Pollut. Atmos. 7, (27), 276-83 (1965) (French).

Three methods for the continuous monitoring of dust emissions from smoke stacks are presented and their advantages and disadvantages discussed. These are (1) optical instruments, (2) electrostatic instruments (Konitest), (3) IRCHA (Institut National de Recherche Chimique Appliquée) instrument based on the measurement of the quantity of dust deposited on a continuous filter by the attenuation of beta-radiation.

289 BREUER, W., Air pollution. Measurement of pollutants. VDI (Ver. Deut. Ing.) Z. 107, (30), 1434-38 (1965) (German). [Fuel Abstr. 7, 2626 (1966)]

Discusses the measurement of concentration of particulate matter in chimneys with special reference to the "Konitest" electrostatic instrument and optical monitors.

290 BULBA, E. and SILVERMAN, L., A mass recording stack monitoring system for particulates. Presented at the 58th Annual Meeting of the Air Pollution Control Association, Toronto, Canada, Paper 65-141, (June 1965). [Fuel Abstr. 8, 505 (1967)]

This paper describes an automatic mass effluent monitoring system under development at Harvard for measuring effluents from steel making operations. The sampling system represents a component of the overall process control system which, in addition to air pollution monitoring, could provide pertinent operating control data, for example, determination of the proportion of a specific element present in the particulates collected in the sample. The apparatus and procedures used incorporate the boundary layer diluter device and use a new stack loading simulating unit. Collection and analysis techniques appear suitable for both laboratory and field conditions.

291 GOLDSCHMIDT, V.W., Measurement of aerosol concentrations with a hot wire anemometer. J. Colloid Sci. 20, (6), 617-34 (1965). [Engineering Index 40 (1966)]

Describes the use of a hot wire anemometer to measure point particle concentration flux in turbulent shear flows; use as size distribution sampler and as device to determine kinematics of suspensions is suggested, calibration results are given.

292 INSTITUT NATIONAL DE RECHERCHE CHIMIQUE APPLIQUÉE, Apparatus for measurement of dust concentrations. Belg. Pat. 665.953 (Oct. 18, 1965).

An apparatus suitable for measurements on air or other gases. The gas is drawn through a filter of paper, felt or textile material, fixed or moving with a controlled velocity. The apparatus has a source of α, β or γ radiation on one side of the filter layer and a radiation detector on the other side, so that the attenuation of radiation caused by the dust is measured. *(Original not consulted.)*

293 KOLBOW, P. and THIENE, R., Smoke density meter for monitoring the amount of dust contained in the flue gases of industrial plants. Siemens Z. 39, (3), 217-19 (March 1965) (German). Siemens Rev. 32, 276-79 (August 1965). [Fuel Abstr. 6, 5725 (1965), 7, 1191 (1966)]

A description of a method for the continuous observation of dust emissions. It consists of a light transmitter and a light sensitive receiver which are so arranged that a beam of light projected by the transmitter passes through the flue gas under test before impinging upon the receiver. A linearising unit acts so that the indication is not dependent on the distance traversed by the beam and enables the scale to be linearly graduated proportionally to the degree of dust concentration.

294 NARJES, L., The use of new zero-pressure probes for quasi-isokinetic sampling in steam power plants. Staub 25, (4), 148-53 (1965) (German). Staub 25, (4), 11-18 (1965) (English translation). [Fuel Abstr. 6, 5141 (1965). Engineering Index 2906 (1966). Chem. Abstr. 63, 8069f (1965)]

This paper describes the application of a new null-probe for sampling high concentrations of dust in coal dust streams and the behaviour of the probes under diverse flow conditions is investigated.

295 NARJES, L., Determining flow densities, particle segregations and time conditioned flow fluctuations during the pneumatic conveyance of bituminous coal by means of the zero pressure probe. Staub 25, (7), 256-60 (1965) (German). Staub 25, (7), 8-13 (1965) (English translation). [Fuel Abstr. 6, 7782 (1965)]

Reports measuring results obtained in the case of dust samples taken by means of a zero pressure probe from horizontal and inclined channels for conveying dust. By evaluating the amount of dust at fixed points of the cross section it is possible to investigate the distribution of dust flow density. The particle size analyses are converted according to the diagram of quantitative dust distribution and are entered on "relative segregation" graphs. In addition, the variations occuring with time in the concentration of the dust-air mixture have been investigated at different points inside a channel and at equal points of a parallel pipe system.

296 QUITTER, V. and ZIMMERMANN, I., The Zyklosond-operational possibilities and practical experiences with a new dust measuring apparatus. Mitt. aus Luft- und Kältechnik 1, 1 (1965) (German), *(Original not consulted.)*

297 REHM, F.R., The method for determining emission characteristics of incinerators (Informative Report No. 2). J. Air Pollut. Contr. Ass. 15, (3), 127 (1965).

This paper discusses the application of the methods recommended in the A.S.M.E. Power Test Code No. 27 and in Western Precipitation Bulletin WP-50 to the measurement of particulate emissions from incinerators. Recommendations are made for the size of nozzles required, the maintenance of isokinetic velocity, and the location of the test site.

298 SCHNÜRCH, G. and PETRUSCH, V., Dust measurements in flue gas from a Thomas converter. Stahl Eisen 85, (24), 1595-1600 (1965) (German). [Fuel Abstr. 7, 1856 (1966)]

Reports measurements carried out to determine the amount, composition and temperature of flue gas, and also the amount and particle size composition of dust in the case of oxygen-steam blowing and oxygen-air blowing.

299 SCHULZ, K.O. and BEGAND, H., Determination of the dust content of flue gases. Mitt. Inst. Energetik. 74, 248-56 (1965) (German). [Fuel Abstr. 7, 3282 (1966)]. *(Original not consulted.)*

300 **THIEME, W.,** Measurement of dust emission from mechanical solid fuel boiler. Staub 25, (6), 226-30 (1965) (German). [Fuel Abstr. 6, 7787 (1965)]

After a description of dust measuring methods and of test conditions, the influence of the boiler design and mode of operation on dust emissions is discussed.

301 **VITOLS, V.,** Theoretical limits of errors due to anisokinetic sampling of particulate matter. Presented at 58th Annual Meeting Air Pollution Control Association, Toronto, Canada (1965). J. Air Pollut. Contr. Ass. 16, (2), 79-84 (1966). [Chem. Abstr. 65, 342c (1966)]

In this paper theoretical estimates of errors resulting when sampling particulate matter with aspirated nozzles under conditions of anisokinetic flow were calculated neglecting gravitational effects. The equations of notion were solved by a procedure combining an analog and a digital computer.

1966

302 Anon, Electrostatic flue dust monitor. Power Works Eng. 61, 32-3 (May 1966). [Fuel Abstr. 7, 6991 (1966)]

The instrument described measures continuously the total surface area of the dust contained in a unit volume of flue gas, which can be directly converted into the total dust burden if the average particle size is known. The monitor is claimed to be more sensitive than photoelectric methods. *(Original not consulted.)*

303 Anon, Grit and dust emission from solid fuel furnaces. Power Works Eng. 61, 21-5 (June 1966). [Fuel Abstr. 7, 8595 (1966)]

Briefly discusses grit and dust measurement; characteristics of grit and dust particles; causes of grit and dust emission. *(Original not consulted.)*

304 Anon, Conference on dust measurement in flowing gases. Dortmund 13-14 December, 1965. Staub 26, (2), 74-5 (1966) (German). [Fuel Abstr. 7, 6185 (1966)]

Summaries of papers presented, covering the subjects of legislation on atmospheric pollution, the types and occurence of dust and the use of filters to prevent dust emission, instruments used for dust measurement, measurement procedures and statistical methods of analysing results for the assessment of dust removal plants.

305 BUDZINSKI, K., Feasibility of studying dust particle flow at the orifice inlet by photographing particle trajectories. Staub 26, (7), 305-6 (1966) (German). [Engineering Index 604 (1967). Fuel Abstr. 8, 2154 (1967)]

Method for rendering visible field of flow at inlet aperture of probes which permits three dimensional field of flow to be recorded photographically; by using stroboscopic illumination it is possible to identify paths of individual particles and particle velocities at any point of field flow.

306 DENZEL, P. and HORN, W., A sensitive measuring method for the continuous determination of gravimetric concentrations of pulverulent emissions. Elektrotech. Z. Ausg.-A 87, (9), 311 (1966) (German).

Two methods for monitoring dust in gases are discussed briefly; the electronic microbalance (Ref. 198) and measurement of the dust after collection on a filter by using beta-radiation (Ref. 273).

307 DIOR, E., Measuring the amount of fly ash in flue ducts using the tribolectric effect. Czech. Pat. 118.708 (June 15, 1966). [Chem. Abstr. 66, 884632 (1967)]

The earlier apparatus in which smoke samples were collected with a probe, is simplified by placing the sensitive element directly inside the flue duct to prevent condensation of water on the cold walls of the probe, and false results owing to the changed composition of the sample are avoided. *(Original not consulted.)*

308 DRESIA, H. and FISCHOETTER, P., Dust content in gases. Ger. Pat. 1.213.642 (1966). [Chem. Abstr. 65, 346c (1966)]

A suction pump samples the gas stream through a filter chamber which contains a moving filter and which is provided with an external radioactive beta-emitter and counting tube with auxiliary equipment to register transmitted and reflected beta-radiation. The accuracy is claimed to be of the order of 0,01 mg/cm^2 of the collected dust sample. *(Original not consulted.)*

309 FRANZKY, U., Photoelectric equipment for measurement of the density of smoke and dust. Wasser. Luft. Betr. 10, (1), 11-17 (1966) (German) [Fuel Abstr. 8, 2766 (1967)]

Relevant laws are discussed, and equipment shown at the "Reinhaltung der Lift" and "Interkama 1965" exihibitions in Düsseldorf is described.

310 GAST, T., Research for the development of a gravimetric automatic recording concentration measuring apparatus for the solid material in flue and waste gases. Westdeut. Verlag. Cologne, Ger. 44 pp (1966) [Chem. Abstr. 69, 15983w (1968)] *(Original not consulted.)*

311 GUSSMAN, R.A. and GORDON, D., Notes on the modification and use of a cascade impactor for sampling in ducts. Amer. Ind. Hyg. Ass. J. 27, 252-5 (1966). [Fuel Abstr. 8, 6902 (1967)]

An earlier duct probe design for the cascade impactor has been redeveloped and a method has been found to prevent deposition of aerosol on the first stage prior to the actual sampling period. A control system has been devised which permits reproducible sampling periods as brief as 0,6 seconds.

312 HØJERGAARD, F., B.P. method for the determination of stack solids in flue gases. Varme 31, (3), 65-68 (June 1966) (Danish). [Fuel Abstr. 8, 524 (1967)]

A simplified B.P. method is described as being more accurate than the method of measuring soot number according to the Baccarah scale. The apparatus used is described. *(Original not consulted.)*

313 KAHNWALTD, H., Dust measurement in flowing gases. Staub 26, (10), 425-6 (1966) (German). Communication No. 579 of the Heat Association of the Vereins Deutscher Eisenhüttenleute, Verlag Stahleisen M.B.H., Düsseldorf, 19 pp (1966). [Fuel Abstr. 8, 5620 (1967). Engineering Index 603 (1967)]

Values of dust content measured in a production plant vary during an operation time for non-steady processes. Therefore, to determine the dust emission accurately the dust measurements must be carried out at as short intervals as possible. When a sufficient number of measured values is available the probable course of the dust emission can be determined by means of probability calculus.

314 KOGLIN, W., Measurements of the dust content and the determination of average values. Aufbereit.-Tech. 7, 629-31 (1966) (German). [Fuel Abstr. 8, 2790 (1967)]

The usual graphical determination of average dust content of flue gas is not sufficiently accurate for many purposes. An equation should be used which combines the arithmetical average of the measured value with the time during which the measurements were taken and the volume of gas withdrawn for measuring dust content. *(Original not consulted.)*

315 KRÜGER, R., Continuous measurement of dust and gas emission. Tech. Uberwach. 7, (2), 71 (1966) (German). Review.

316 LEONARD, J.S., Stack emission sampling. Tappi 49, (10), 84A-85A (Oct. 1966)

Sampling of solid particulates and malodorous gases from Kraft pulp mills effluent streams is described. Recommendations are made as regard sampling locations and probe construction.

317 MAGNUSZEWSKI, A. and POLANIEKI, E., Photoelectric device for the detrmination of dust content. Pol. Patent. 52.190 (Oct. 24, 1966). [Chem. Abstr. 67, 111226f (1967)]

The device described is designed for measuring the dust content of gases in factory stacks. The lenses of the instrument require no cleaning for 3-6 months. *(Original not consulted.)*

318 MUHLRAD, W., Use of zero pressure probes for measuring the dust content in conduits. Staub 26, (7), 302-4 (1966) (German). [Engineering Index 604 (1967)]

Practical experience shows that null probes exhibit errors in air flow rates which may amount to 18%. These faults are explained by the formation of a boundary layer in the immediate region of the probe wall. A theoretical investigation and practical tests appear to confirm this assumption. The obvious remedy here is a suitable increase in probe diameter at the level of the measuring point for static pressure, in proportion to probe inlet diameter.

319 PROCHAZKA, R., Recording dust measurements with the "Konitest" instrument. Staub 26, (5), 202-6 (1966) (German). Staub 26, (5), 22-8 (1966) (English translation). [Chem. Abstr. 65, 14856f (1966). Fuel Abstr. 7, 6976 (1966). Engineering Index 603 (1967)]

Two modifications of the "Konitest" dust sampling apparatus are described; the turbulence type and the venturi nozzle type; minimum indicating limit of "Konitest" is about 1 mg/m^3; apparatus has proved itself for recording measurements of dust content of industrial gases and measuring dust concentration at working places.

320 QUITTER, V. and BALDAUF, P., Continuous monitoring of dust in a gas at high temperature and pressure. East. Ger. Pat. 51.470 (1966). [Chem. Abstr. 66, 117104r (1967)]

The electrostatic charging of dust as the gas stream passes through a metal screen is used to monitor the dust content continuously. The screen is fabricated from sheet metal; the insulation from either quartz or porcelain. The wire gauze acts as an electrode. *(Original not consulted.)*

321 QUITTER, V. and BALDAUF, P., Equipment for the continuous measurement of the dust content in gases at high temperatures and pressures. East. Ger. Pat. 51.719 (Dec. 1966). [Chem. Abstr. 71, 15834g (1969)]

The equipment was developed especially to measure exhaust gases of a generator which burns solid fuel material. A by-pass of the gas crosses a high pressure tube where triboelectricity is measured indicating low dust contents. Afterwards an apparatus measures high dust contents pneumatically. Temperature and pressure may attain 400°, 25 atm respectively. *(Original not consulted.)*

322 QUITTER, V., MODDE, P. and MUELLER, H., Flue dust measuring equipment. East. Ger. Pat. 52.003 (1966). [Chem. Abstr. 66, 87039d (1967)]

The unit described is suitable for the examination of gases at high temperature and pressure, e.g., as produced by gasification plants. A sampling probe is connected by valves to a cyclone which is linked via further valves to a conventional measuring device. Between the sampler and the cyclone a branch is provided so that after a measurement has been completed, steam may be blown through to remove accumulated solid matter. The equipment is heated electrically to 400°. *(Original not consulted.)*

323 SCHMIDT, G., Density measurements on smoke and dust using the extinction principle. Elektrizitaetswirtschaft 65, (24), 740-3 (1966) (German). [Fuel Abstr. 8, 3513 (1967)]

Describes measuring device which works on optical and electrical extinction principle. Optical path of rays, mathematical principles for indication and relation of values indicated to actual dust content discussed. *(Original not consulted.)*

324 SCHÜTZ, A., Recording electrical-contact dust measuring instruments with logarithmic output. Staub 26, (5) 198-201 (1966) (German). Staub 26, (5), 18-22 (1966) (English translation). [Chem. Abstr. 65, 14856h (1966). Fuel Abstr. 7, 6975 (1966). Engineering Index 603 (1967)]

Dust particles pick up an electric charge as they contact a probe situated in a sampling tube; the charge is subsequently removed, amplified and recorded. The concentration measured in this way is a logarithmic function of both particle size and number of particles. The instrument is particularly suitable for measuring large variations in dust content. The apparatus is described in detail and its operation illustrated by several examples.

325 SCHÜTZ, A., Methods for measuring and monitoring dust concentrations. Staub 26, (10), 409-15 (1966) (German). [Engineering Index 603 (1967). Fuel Abstr. 8, 1369, 4260 (1967)]

Different methods for recording dust measurements is reviewed. The following methods are discussed in particular: optical methods; extinction and scattered light measurements; nuclear radiation methods; attenuation of beta-rays; electrical methods; ion accumulation and contact electricity. The design and mode of operation of the instruments are described. In addition the relationship between the instrument reading and gravimetric dust concentration is shown.

326 SEHMEL, G.A., Subisokinetic sampling of particles in an air stream. Battelle Memorial Institute, Pacific Northwest Laboratory, BNWL-217, (March 1966). *(Original not consulted.)*

327 SHORT, W., Measurement of grit and dust emission. Fuel Econ. 44, 89-91 (1966). [Fuel Abstr. 7, 8593 (1966)]

Discusses grit and dust emission standards; sampling problems; typical results; oil fired plant. *(Original not consulted.)*

328 STRAUSS, W., Industrial gas cleaning. The principles and practice of the control of gaseous and particulate emissions. International series of monographs in chemical engineering Vol. 8, Pergamon Press, New York, 471 pp, (1966). [Chem. Abstr. 65, 14484d (1966). Fuel Abstr. 8, 2795 (1967)]

Section 2.8. Isokinetic sampling and probes for solid and liquid particles. Errors resulting from anisokinetic sampling and from the use of null probes are reviewed. The B.C.U.R.A. probe is illustrated and described, and also the International Flame Research Foundation high temperature probe. The construction of high temperature probe is outlined.
Section 2.9. Sample collectors for solid and liquid particles, characteristics of cyclone probes, alundum, fibre glass and paper thimbles are described. A thermal precipitator is illustrated.

329 VEREIN DEUTSCHER INGENIEURE, Performance measurements and dust collectors. V.D.I. Richlinie reinhaltung der luft 2066, 21 pp (May 1966) (German).

Design and operation of the most widely used dust content measuring instruments are dealt with, as well as the magnitude of errors liable to occur and their effect on the final result.

330 WEBER, M., A new instrument for the continuous measurement of the dust content. Tech. Uberwach 7, 337-9 (1966) (German). [Fuel Abstr. 8, 2161 (1967)]

An instrument has been developed which uses the additional pressure drop during changes in velocity of dust laden gas as an indication of the dust load. The instrument has been tried out successfully in an industrial installation but its accuracy and response time have still to be improved.

1967

331 ACHINGER, W.C. and SHIGEHARA, R.T., A guide for selecting sampling methods for different source conditions. Presented at 60th Annual Meeting of the Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967. J. Air Pollut. Contr. Ass. 18, (9), 605-9 (1968). [Engineering Index 68, 78 (1969). Fuel Abstr. 10, 5143 (1969)]

This paper classifies the variations in measurements with time and with location within the duct work into four categories and suggests basic sampling approaches for each type of source condition, thus serving as a guide when planning source sampling programs. Several published methods are evaluated and classified according to the source conditions to which the method is applicable.

332 Anon, Grit and dust : the measurement of emissions from boiler and furnace chimneys. Ministry of Housing and Local Government, London, H.M.S.O. 10 pp (1967). [Fuel Abstr. 9, 4399, 6546 (1968)]

Range of furnaces covered, method of sampling, B.C.U.R.A. probe, choice of sampling position, general notes on sampling and recommended maximum levels of emission.

333 Anon, How much dust in flue gas? Power 111, 86-7 (May 1967). *(Original not consulted.)*

334 Anon, Sampling airborne solids in duct following a 90° bend. J. Air Pollut. Contr. Ass. 17, (9), 605 (1967).

Reports on research being done at the University of Michigan.

335 Anon, Source sampling for atmospheric pollutants. U.S. Department of Health, Education and Welfare. Public Health Service, Bureau of Disease Prevention and Enfironmental Control, National Center for Air Pollution Training Program (1967). *(Original not consulted.)*

336 BAUM, F. and BEINE, H., Investigations into the adsorption of SO_3 by glass fibre filters used for dust concentration measurements in gas streams. Gesundh.-Ing. 88, (11), 350-3 (1967) (German). [Air Pollut. Abstr. 2, (3), 64 (1971)]

The adsorption of sulphur trioxide by the type of glass fibre filters used for dust sampling is investigated.

337 BAUM, F. and REICHARDT, I., Error in measurement of solid matter concentration in waste gas by adsorption of sulphur trioxide on a filter. Staub 27, (9), 392-5 (1967) (German). Staub 27, (9), 18-22 (1967) (English translation). [Chem. Abstr. 68, 5995s (1968). Fuel Abstr. 9, 1421, 3751 (1968)]

The change in weight of filters used for filtering particulates from gases in the presence of sulphur trioxide is discussed.

338 BENARIE, M. and BODIN, D., Development and testing of an instrument for the continuous measurement of dust emissions by the absorption of beta-rays. Pollut. Atmos. 9, (35), 147-55 (1967) (French). [Chem. Abstr. 70, 90538d (1969). Fuel Abstr. 9, 6548 (1968), 10, 531 (1969)]

339 BERNERT, J., Recent research on emissions of industrial plants. Chimia 21, (7), 285-90 (1967) (German). [Chem. Abstr. 67, 76087n (1967)]

A review of methods and apparatus for dust sampling.

340 BERNERT, J. and JANOTT, H., A modified standard dust measuring instrument and its practical application in high temperature processes and industrial waste incineration plants. Wasser, Luft. Betr. 11, (4), 204-7 (1967) (German). [Fuel Abstr. 8, 5016 (1967)]

A number of instruments are in use for measuring dust concentration in industrial gases, in particular the fine dust measuring instrument of the type "Lurgi Ströhlein" which is frequently used because it is convenient for sampling inaccessible or very hot sites. On the basis of long experience on the practical use of this equipment some modifications both to the sampling units and to the monitoring assembly were decided upon. In this paper their performance in sampling high temperature processes and industrial waste incinerators is reported.

341 BOHNET, M., Determination of dust content in flowing gases by means of suction probes. Chem. Ing. Tech. 39, (16), 972-7 (1967) (German). [Fuel Abstr. 9, 2245 (1968)]

Calculation of the field of flow in the region of the probe mouth makes possible the determination of the tracks of the solid particles and thus enables a prediction to be made of the possible errors.

342 BOOTHROYD, R.G., An anemometric isokinetic sampling probe for aerosols. J. Sci. Instr. 44, (4), 249-53 (1967). [Chem. Abstr. 66, 88887r (1967). Fuel Abstr. 8, 5019 (1967)]

A new type of probe for the isokinetic sampling of aerosols is described. The instrument comprises essentially a hot wire anemometer together with potentiometer and a reversible sample probe. Examples of test results for a particular instrument are given. The sampling can be easily and quickly adjusted to isokinetic flow with less than a 2% error in the sampling velocity. The necessary techniques and precautions for constructing and operating an instrument of arbitrary configuration are outlined.

343 BUKER, D. and GAST, H.T., Continuous gravimetric dust measurement by mechanical resonance. Chem. Ing. Tech. 39, (16), 963-6 (1967). [Fuel Abstr. 9, 503 (1968)]

Experiments which are described have shown that a quantity of dust can be measured by way of the changes in the natural frequency of a transversally oscillating band in vacuum. On this basis it could be possible to develop a sensitive continuous measuring system for suspended particles. The measured values could be recorded.

344 COENEN, W., A new principle of a recording dust measuring method and its technical application to a battery operated instrument. Staub 27, (12), 540-46 (1967) (German). Staub 27, (12), 32-9 (1967) (English translation). [Fuel Abstr. 9, 5149 (1968)]

In the method described, air containing dust is passed through an electric condenser. The current subsequently carried by the particles serves as a measure of dust concentration. The instrument is suitable for measuring the relative concentration of all solid dusts. The smallest detectable size is below 1 micron.

345 CUTTING, K.R., Methods of measurement of solid emissions. Combustion Association Meeting. Report Doc. No. 8327, p 11-16, 3 April, 1967. [Fuel Abstr. 9, 2246 (1968)]

Description is given of the B.C.U.R.A. probe and of the B.P. stack solids apparatus.

346 DAVIES, C.N., Effect of a cross wind when sampling dust particles through an orifice in the base of a horizontal cylinder. Brit. J. Appl. Phys. 18, 1787-92 (1967). Engineering Index 718 (1968). [Fuel Abstr. 9, 3034 (1968)]

Air containing particles is sucked into orifice in underside of bulky sampling head which is idealized for analysis in two dimensions as horizontal cylinder with line sink; equations are given for motion of particles around and into sink when wind blows past in horizontal direction; fluid motion is ideal and inertia of particles, which are settling under gravity, is neglected; particle trajectories are calculated when wind velocity is of same magnitude as rate of particle.

347 DEBRUN, G., Continuous measurement of the dust content of flue gases in the large power stations of the Electricité de France. Pollut. Atmos. (34), 84-90 (1967) (French). Staub 28, 76 (1968) (German). [Fuel Abstr. 9, 6549 (1968)]

This article describes research carried out by the E.D.F. on instruments for the continuous measurement of dust emissions. Different instruments were tested, optical density meters and a small electrode deduster in particular.

348 DELANGE, J.E., A critical look at methods, procedures and apparatus for evaluating the effectiveness of dust arresting equipment on large coal fired steam generators. Paper presented at the 60th Annual Meeting of the Air Pollution Control Association, Cleveland, 14 pp (1967). [Pollut. Atmos. (41) 54 (1969) (French)]

This paper presents a review of the test methods, procedures and apparatus based on the experience of the Detroit Edison Company in conducting performance tests on mechanical dust collectors and electrostatic precipitators on large coal-fired steam generators. A special test apparatus, which employs the null sampling method for determining the dust concentration in a gas stream, is described and the advantages of the use of this type of apparatus for certain applications are noted. Further developments of the null method of sampling is proposed as well as the establishment of standard test procedures and apparatus for specific applications.

349 HEYNE, L. and WERTHOF, K.A., Problems of the determination of the soot content with oil fired plants. Tech. Uberwach. 8, (5), 157-61 (1967) (German). [Fuel Abstr. 8, 6908 (1967)]

The use of isokinetic gas sampling makes it possible to achieve accurate results by the Bacharach method for heavy oil fired plants, as a statistically representative sample of the solids contained in the flue gas is taken.

350 HICKS, C.E., Sensor measures stack effluents accurately. Petro./ Chem. Eng. 39, (5), 33-4 (1967). [Chem. Abstr. 67, 36111j (1967)]

An optical smoke monitoring device is described in which the light intensity is measured by a bolometer calibrated in grams/ft^3. *(Original not consulted.)*

351 HICKS, D., The emission of grit and dust from furnaces. Paper read at the Clean Air Converence, Blackpool, 17-20 October, 1967. Reprint National Society for Clean Air, London, pp 79-87 (1967). [Fuel Abstr. 9, 487 (1968)]

Methods of sampling grit and dust are first discussed in terms of the essential principles governing the selection of a standard method and then the method selected by the Grit and Dust Working Party is described.

352 HORN, W., A contribution to continuous gravimetric electrical concentration determination of pulverulent emissions. Diss. Th., Aachen (1967) (German). *(Original not consulted.)*

353 KATZ, J. and VERROCHI, W.A., A filter test method for the rapid weight distribution of dust in gas streams for the evaluation of dust collectors. Presented at 60th Annual Meeting of the Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967. J. Air Pollut. Contr. Ass. 18, (6), 401 (1968). [Fuel Abstr. 9, 8952 (1968)]

This paper describes a simple quantitative filter test method that was developed to evaluate dust collector performance by a short term gravimetric sample. This method was used as a field tool to diagnose equipment malfunctions or to ascertain collector changes caused by variations in process operations. While this method is not considered a replacement for accepted standard stack test methods, the reproducibility and ease of handling the apparatus suggested that others may effectively in the field.

354 KEUL, W., Problem of soot determination in oil burning equipment. VDI (Ver. Deut. Ing.) Z. 109, (17), 755 (1967) (German). [Fuel Abstr. 10, 523 (1969)]

Since the Baccharach apparatus is accurate for the determination of particulate emissions from light but not heavy oils, a new sampling device was developed. It allows isokinetic sampling thereby trapping coarser particles which escaped previously. Isokinetic rate can be maintained even in the case of changing gas velocities. The device is useful for calibrating smoke density meters.

355 LUCAS, D.H. and SNOWSILL, W.L., Some developments in dust pollution measurement. Atmos. Environ. 1, 619-36 (1967). [Fuel Abstr. 9, 4400 (1968)]

Optical density dust monitor is described. Everclean window is mentioned.

356 LUNDGREN, D. and CALVERT, S., Aerosol sampling with a side port probe. Amer. Ind. Hyg. Ass. J. 28, 208-15 (1967). [Fuel Abstr. 9, 507 (1968)]

This report describes an experimental investigation of a side port probe and a conventional sampling probe for obtaining aerosol samples from a duct. Sampling bias for both types of probe was determined experimentally over a wide range of test conditions using monodisperse aerosols from 0,5 to 10 microns diameter. Sampling bias was shown to be a function of the inertial impaction parameter and duct to probe velocity ratio. Experimental results are presented.

357 MANDERSLOOT, W.G.B., Proposals for a simplified method for the sampling of dust emitted by fuel burning appliances for use by local authorities. CSIR (Counc. Sci. Ind. Res., S.Afr.) Report : File 6651/4510/4/2/2, 7 pp (1967).

The outline presented is for dust emission measurements on appliances burning more than 250 lb/h of coal and having flues and chimneys smaller than 3 ft in diameter. A four point cumulative sample is to be obtained by isokinetic sampling with a "null type" probe.

358 PETERS, D.L., Special techniques for sampling of flows containing solids, reactive fluorides and liquid droplets. CSIR (Counc. Sci. Ind. Res., S. Afr.) Contract Report C Chem 164, 49 pp (1967).

This report describes special techniques for simultaneous measurement of gas velocity, dust and fluoride concentration in flows containing droplets, with special reference to sampling in superphosphate plants for the determination of the gaseous fluoride content of the stack gas. Of particular interest is the use of Teflon felt for filtering out dust in the presence of gaseous fluoride.

359 RENZANIGO, F., A method for gravimetric determination of solids in exhaust gases. Riv. Combust. 21, (2), 80-6 (1967) (Italian). [Chem. Abstr. 67, 57049k (1967). Fuel Abstr. 8, 6898 (1967)]

A description is given of the method developed by the Stazione Sperimentale Peri Combustibili. The volume of exhaust gases and their composition are determined by withdrawing samples isokinetically through a stainless steel tube inserted into the smoke stack of heat generators. The gas samples are cooled and passed filtered through a tared silica wool filter. *(Original not consulted.)*

360 RENZANIGO, F., Analytical determination of smoke pollutants from combustion in domestic heating units. Riv. Combust. 21, (10), 506-20 (1967) (Italian). [Chem. Abstr. 68, 81176r (1968)]

Smoke analysis was made by optical density, Temperature, particulates, fuel analysis, burner operation characteristics, SO_2 and SO_3 were determined. *(Original not consulted.)*

361 SANSONE, E.B., Sampling airborne solids in ducts following a 90° bend. Ph. D. Thesis, University of Michigan (1967). [Diss Abstr. 28, (10/12), 5096B (1968)]

The objectives of this study were to evaluate the sampling procedure commonly used for the quantitative determination of the mass of solids associated with a volume of gas and to reveal the patterns of flow of solids downstream of a 90° bend. Particle concentrations were measured by drawing the air solids mixture into a sampling probe isokinetically and deposing the solids on a filter. The volume of air passing through the filter was measured. *(Original not consulted.)*

362 SANSONE, E.B. and GIEVER, P.M., Sampling airborne solids in a duct following a 90° bend. Air Pollut. Contr. Ass. J. 17, 605 (1967).

Brief report of research done at the University of Michigan on sampling skewed concentration profiles following a 90° bend.

363 SEHMEL, G.A., Errors in the sub-isokinetic sampling of an air stream. Amer. Occup. Hyg. 10, (2), 73-82 (1967). [Fuel Abstr. 8, 7688 (1967), 9, 5145 (1968)]

Effects of deviation of particle trajectories from streamlines for sub-isokinetic flows at low sampling rates were experimentally determined. (See Ref. 364). *(Original not consulted.)*

364 SEHMEL, G.A., Estimation of airstream concentrations of particles from sub-isokinetically obtained filter samples. Amer. Ind. Hyg. Ass. J. 28, (3), 243-53 (1967). [Fuel Abstr. 9, 501 (1968)]

(Same paper as Reference 363 with different title.) Experimental estimates of errors in the measurement of concentrations of particulates in air from sub-isokinetically obtained samples were determined for a 1,65 inch diameter filter holder geometry. Sampling velocities were from 0,008 of isokinetic to isokinetic for air velocities from 2,7 to 30 mph. Impaction efficiencies with no flow through the filter were determined for the lower limit of the model used to correlate the data. The model was used to calculate curves for comparison with the experimental data for finite sub-isokinetic sampling rates and to calculate concentration corrections as a function of particle size, sampling rate and air velocity.

365 SEHMEL, G.A. and SCHWENDIMAN, L.C., Particle deposition within a curved sampling probe. Pacific Northwest Laboratory Annual Report to the USAEC Division of Biology and Medecine. Battelle Memorial Institute, Richland, Washington Vol. II, Part 3, p 88-92 (1967)

Particle deposition was measured in 4,7 and 5,8 inch lengths of 0,135 to 0,40 inch ID Tubing formed on a 4,4 inch radius of curvature. For a constant sampling velocity, the deposition increased with an increase in particle size and a decrease in tubing ID. For a constant tube ID, deposition increased with both flow rate and particle size until re-entrainment became important. For transition flow between laminar and turbulent, the deposition was minimum for an intermediate Reynolds number for any constant particle size for which re-entrainment was not important. The deposition was significant for all flow rates and must be considered in interpreting the data for any sample passed through a curved tube in either laminar or turbulent flow.

366 SEHMEL, G.A. and SCHWENDIMAN, L.C., The effect of sampling probe diameter on sampling accuracy. Pacific Northwest Laboratory Annual Report to the USAEC Division of Biology and Medecine, Battelle Memorial Institute, Richland, Washington Vol. II, Part 3, p 92-5 (1967).

Uranine particles of a single size (1 to 28 microns diameter) were isokinetically sampled through 0,135, 0,210, 0,245 and 0,402 inches. ID probes whose inlets were located on the axis of a 2,81 inch ID verticle tube. Sampling velocities from 18,0 to 19,6 ft/sec were equal to the maximum centerline velocities of the sampled tube. The measured concentrations from the sampled air ranged from about 0,8 to 1,2 times the average concentrations in the sampled tube. The measured concentrations are a function of the probe diameter and also are affected by the preferentially enhanced concentration of large particles in the region next to the sampled tube wall.

367 SHERMAN, P.R., Emission sampling for electric furnace fume control. J. Metals 19, (3), 68-72 (1967). [Chem. Abstr. 67, 57048j (1967). Fuel Abstr. 9, 504 (1968)]

Descriptions are given of the equipment and methods used by Union Carbide Corp. The presentation is directed to those who are not yet directly involved in the details of sampling, and especially to those who will be requesting or proposing that a sampling program be undertaken. The equipment described consists of an isokinetic sampling probe with dust collection on a paper thimble. Examples of calculations are given.

368 SMITH, W.S., MARTIN, R.M., DURST, D.E., HYLAND, R.G., LOGAN, T.J. and HAGER, C.B., Stack gas sampling improbed and simplified with new equipment. Presented at the 60th Annual Meeting of the Air Pollution Control Association, Cleveland, Ohio, Paper No. 67-119, 23 pp (June 1967).

Commercially available equipment necessary for isokinetic sampling of process gases proved cumbersome and inadequate for recent atmospheric emission studies of chemical and combustion processes. The Public Health Service has therefore designed a compact, portable, sturdy stack sampling train capable of collecting solids, mists and gaseous pollutants from most chemical and combustion processes. This paper presents the theory, design and operation of the stack sampler (Pitobe) and a discussion of its application to date.

369 UZIMA, M., Simplified method of measuring quantity of soot and dust and its relation to a smoke chart. Netsu Kanri 19, (1), 11-16 (1967) (Japanese). [Fuel Abstr. 9, 8066 (1968)]

The soot and dust concentration were measured using a photoelectric soot and smoke meter. Measurements were also made using a constant velocity suction tube. *(Original not consulted.)*

370 WINKEL, G., Flow investigations with the aid of a thermistor as illustrated by its use with the sampling probe. Staub 27, (12), 551-4 (1967) (German). Staub 27, (12), 46-50 (1967) (English translation). [Engineering Index 718 (1968). Fuel Abstr. 9, 5217 (1968)]

The author gives a report on the use of a hot conductor for measuring flow velocity. Flow conditions in the suction range of sampling probes, used for determining dust content of flowing gas, are investigated and the results discussed by means of a practical experience.

1968

371 AIR FLOW DEVELOPMENTS LTD., New dust and smoke monitor. Smokeless Air 39, (147), 59-61 (Autumn 1968). [Fuel Abstr. 11, 559 (1970)]

Optical density probes of the S.E.R.O.P. type are described.

372 Anon, Measurements of emissions at cupola furnaces. Wasser. Luft. Betr. 12, (10), 620-21 (1968) (German). [Fuel Abstr. 10, 2187 (1969)]

Reports on the technology of the furnace, limiting dust ejection and measuring emissions.

373 COOPER, H.B.H. and ROSSANO, A.T., Air pollution - Sampling and analysis. Chem. Engng. (New York) 75, (22), 142-6 (Oct. 14, 1968). [Fuel Abstr. 10, 2883 (1969)]

Measuring gas properties in the duct; withdrawing representative samples; and accurate analysis are described.

374 DAVIES, C.N., The entry of aerosols into sampling tubes and heads. Brit. J. Appl. Phys. 1, (Ser. 2), 921-32 (1968). [Engineering Index 68, 77 (1969)]

The entry of aerosols into sampling orifices is discussed. Tables are given for evaluating sampling efficiency in wind. Calm air being defined by wind speed being less than value which is dependent on sampling speed and particle size (see Ref. 375).

375 DAVIES, C.N., Sampling of aerosols - Entrance of particles into the probe nozzle and heads. Staub 28, (6), 219-25 (1968) (German). Staub 28, (6), 1-9 (1968) (English translation). [Fuel Abstr. 9, 8059 (1968), 10, 2195 (1969)]

The entry of aerosols into sampling orifices is discussed. A small sampling tube is defined as one for which the sampling efficiency does not depend on orientation. Limits of small tube sampling are given in terms of tube radius, particle size and aspiration speed. The efficiency of a large tube varies if the orientation is changed. Effects of settlement due to gravity and ambient wind are discussed. Isokinetic sampling with a small tube facing the wind may be necessary for high efficiency. A formula gives the efficiency when sampling and wind velocities differ. The behaviour of aerosols sampled with bulky heads is described.

376 DELANGE, J.E., Evaluating dust arresting equipment on large coal fired steam generators. J. Air Pollut. Contr. Ass. 18, (2), 95-7 (1968). [Fuel Abstr. 9, 5831 (1968)]

Reviews the experience of the Detroit Edison Co. in conducting performance tests. Recommendations are made regarding the location of the test section, and a description given of the sampling probe and null nozzle used. (See Ref. 348.)

377 DORSEY, J.A. and KEMNITZ, D.A., A source sampling technique for particulate and gaseous fluorides. J. Air Pollut. Contr. Ass. 18, (1), 12-14 (1968). [Engineering Index 71 (1968)]

An apparatus for the separation and collection of gaseous and particulate fluorides is described. Heated glass probe served as reactor for converting hydrogen fluoride to silicon tetrafluoride before particulates were filtered.

378 DÜWEL, L., Latest state of development of instruments for the continuous monitoring of dust emissions. Staub 28, (3), 119-27 (1968) (German). Staub 28, (3), 42-53 (1968) (English translation). [Engineering Index 68, 693 (1969). Fuel Abstr. 9, 6545 (1968), 10, 6628 (1969)]

The different measuring methods are explained and characteristics of the types of instruments manufactured are given. The Gast balance is the only one whose principle permits a quasi continuous gravimetric dust measurement to be made. All the other instruments do not measure the gravimetric dust content,but only an auxiliary physical value.

379 EICKELPASCH, D., Problems of intermittent gravimetric dust measurement. Staub 28, (5), 197-200 (1968) (German). Staub 28, (5), 25-8 (1968) (English translation). [Chem. Abstr. 69, 89524u (1968). Fuel Abstr. 9, 8924 (1968), 10, 6629 (1969). Engineering Index 68, 693 (1969)]

The varying dust discharge occuring in industrial batch processes and particularly in the metallurgical industry can be determined in a reliable way by gravimetric short time measurements. With the help of a new multiple chamber dust measuring apparatus and a measuring arrangement partly automated by means of magnetic values and electric short time meters, and also with the help of a measuring point control system, it is possible to simplify the test procedure to such an extent that also the dust discharge in short time processes can be followed quasi-continuously.

380 FLUX, J.H., SMITHSON, D.J. and SMITHSON, R.N., Simplified dust sampling apparatus for use in iron and steelwork. J. Iron Steel Inst. (London) 206, (12), 1188-93 (1968). [Fuel Abstr. 10, 3694, 6631 (1969)]

The development of a simple but reliable sampling probe for dust loading, particle size and particle shape determination is described. Although designed to meet the specialized requirements of iron and steel works the equipment and techniques could well find applications in other industries.

381 HAALAND, H.H. (editor), Methods for determination of velocity, volume, dust and mist content of gases. Bulletin No. WP-50, Western Precipitation/Joy Manufacturing Co., Los Angeles, California, 7th ed., 37 pp (1968).

The purpose of this bulletin is to outline a standard method of procedure for the study of gas streams contained in industrial flue systems, and the suspended matter carried by these gases. Various other methods are also mentioned. Choice of sampling station and sampling equipment are described.

382 HAASE, W., New dust concentration measurement equipment used in cement works in East Germany. Silikattechnik. 19, (6), 180-1 (1968) (German).

A new sampling probe for determining the dust content in flowing gases was tested in cement works using different processes. Its design, development and characteristics are briefly described. A simple construction and easy operation makes this instrument suitable for dust measurements in all industries.

383 HABEL, K., The separation of gaseous and solid fluorine compounds during air quality measurements. Staub 28, (7), 283-6 (1968) (German) Staub 28, (7), 26-31 (1968) (English translation). [Engineering Index 68, 694 (1968)]

Solid fluorine compounds were separated from gaseous compounds with help of quartz filter head by using diaphragm filters. Filter is located upstream of absorber for gaseous compounds. Dust deposited on filter is prepared together with filter for fluoride determination; by weighing filter it is also possible to carry out dust content determination.

384 HICKS, R.E., Flue gas sampling at Lodge Cottrell Ltd., CSIR (Counc. Sci. Ind. Res., S. Afr.) Special Report Chem 81, 10 pp (1968).

The sampling procedure used at Lodge Cottrell is described and compared with that used at the CSIR. The most significant difference is that the former uses a single filter traverse-equal area evaluation method as opposed to the multifilter and surface fitting evaluation technique adopted by the CSIR.
The relative merits of the two methods are discussed in detail and it is suggested that the single filter method with its inherent time and labour saving advantages be used in ducts or stacks where the dust distribution is not obviously uneven.

385 HORN, W., Method for continuous gravimetric determination of the concentration of emitted dusts. Staub 28, (9), 364-7 (1968) (German). Staub 28, (9), 20-5 (1968) (English translation). [Chem. Abstr. 70, 22718n (1969). Engineering Index 68, 692 (1969). Fuel Abstr. 10, 2897 (1969)]

An indirect continuous measuring method for the gravimetric determination of dust concentration is described. It is independent of the particle structure; and is based on the absorption of radioactive rays depending on the surface mass. The separation and concentration of aerosols are carried out in a specially designed electroprecipitator. Rays of radioactive isotope C-14 penetrate the collecting electrode, which is moving continuously together with the specimen to be measured. The sensitivity of measurement can be varied over a wide range.

386 JOCHEMS, J., An apparatus for the continuous monitoring of the dust concentration in a gas stream. TNO Nieuus 23, 143 (1968) (Dutch).

A device is described which monitors and records the dust concentrations in a gas stream. The apparatus described is the "Konitest" of Feifel and Prochazka (Ref. 238).

387 KAHNWALD, H., Evaluating dust measurements from an intermittently operating production plant. Staub 28, (5), 195-6 (1968) (German). Staub 28, (5), 22-4 (1968) (English translation). [Fuel Abstr. 9, 8919 (1968)]

Values for dust content Y_t measured in a plant using batch operation vary as $Y = f(t)$ so that the values measured at time intervals during the operation cannot be simply averaged. The least squares adjustment must be used to obtain an accurate result. An example is given for the case of a stochastic and also for a non-stochastic relationship between the dust discharge and operating time.

388 LIEBERMAN, A., Automatic and remote monitoring of airborne particles. Heat. Piping Air Cond. 40, (11), 117 (1968).

Computer system improves sampling, analyzing techniques, avoids usual problems of monitoring. In this paper, the magnitude of errors due to anisokinetic sampling and deposition of dust in sampling probes is shown graphically.

389 LUCAS, D.H. and SNOWSILL, W.L., Routine dust measurement methods developed at Central Electricity Research Laboratory. Paper presented at the Clean Air Conference, Harrowgate, pp 112-125 (Oct. 1968). [Fuel Abstr. 10, 2896 (1969)]

A recording monitor applies increasing emphasis as the dust diameter rises from 20 to 100 microns. Improved smoke meters were tested and a way of converting smoke density readings into Ringelmann number is proposed. Central Electricity Generating Board policy on dust monitoring is outlined. *(Original not consulted.)*

390 McSHANE, W.P. and BULBA, E., Automatic stack monitoring of a basic oxygen furnace. J. Air Pollut. Contr. Ass. 18, 214-5 (1968). [Fuel Abstr. 9, 2927 (1968)]

An A.I.S.I. continuous automatic stack monitor was installed at the stack outlet of an electrostatic precipitator which collected fumes from a basic oxygen process. The performance of the monitor, which worked on the principle of the attenuation of a beta-radiation, was evaluated in a comprehensive long period continuous field study. The output was calibrated by simultaneous isokinetic field samples analysed gravimetrically. Field calibrations confirmed laboratory results. The device responded promptly to variations in fume concentration induced by changing the activation of the fume collector.

391 MION, J., Observations on the use of isokinetic sampling. Inform. Aeraul. Therm. 5, (18), 19-22 (Sept. 1968) (French). [Fuel Abstr. 10, 6627 (1969)]

The size of the dust generally present in gas flows necessitates a sampling method which does not disturb the flow where sampling is done. Thus basically the main stream velocity should not be altered at the inlet of the probe. The isokinetic probe is easy to use for it can set by a simple zero adjustment. A study of its aerodynamic characteristics and therefore of its accuracy is essential. *(Original not consulted.)*

392 MONSTADT, H., Gravimetric measurement of dust concentration in a gas stream. Tech. Uberwach. 9, (11), 377-80 (1968) (German). Abs. in Pollut. Atmos. (48), 289 (1970).

The principle of gravimetric dust determination is explained schematically. Errors to be avoided are discussed, in particular that arising from anisokinetic sampling.

393 NARJES, L., Dust sampler equipment for quasi isokinetic sampling by means of novel zero pressure probes. Chem. Age India 19, (8), 595-603 (1968). [Chem. Abstr. 69, 99165c (1968)]

Application of new zero pressure probe for taking dust samples at high concentrations in coal dust streams and behaviour of probes under diverse in-flow conditions in test channel is investigated. Results of measurements on conveying lines for coal dust at steam power plant are reported. It is possible to investigate distribution of dust density by this device. *(Original not consulted.)*

394 PARKER, G.J., Some factors governing the design of probes for sampling in particle and drop laden streams. Atmos. Environ. 2, (5), 477-90 (1968). Engineering Index 68, 78 (1969). [Fuel Abstr. 10, 2886 (1969)]

Several factors have an important bearing on the design of probes which are required to yield representative samples. In this paper, methods for obtaining isokinetic samples and the effect of the shape of the probe inlet are discussed. Also limitations on the size of the probe bore and its passage length are examined in the light of limited sampling time, particle deposition in situations where the flow is either laminar or turbulent, and compressibility effects when sampling in high velocity gas streams. Graphs are presented to assist with the selection of probe dimensions for sampling in air at 760 mm and 20°C.

395 PARKINSON, M.J., Measurement of the mass flow rate of airborne powdered material in a duct. J. Sci. Instr. 1, 823 (1968).

A description is given of two instruments developed to provide, in combination, absolute on stream measurement of mass flow of powdered materials. They are an ultrasonic velocity meter and a density meter relying on beta-ray attenuation.

396 PROCHAZKA, R., Continuous dust measurement in work areas and industrial plants. Arch. Eisenhuettenw. 39, (6), 439-47 (1968) (German). [Chem. Abstr. 69, 61384z (1968). Engineering Index 68, 693 (1969). Fuel Abstr. 10, 4445 (1969)]

Description of principle and operation of 3 modifications of "Konitest" electric-contact measuring device. Examples of application include measurements at a grey iron foundry and a sinterplant for iron ore. The measurement threshold is 1 mg/m^3.

397 REIST, P.C. and BURGESS, W.A., A comparative evaluation of three aerosol sensing methods. Amer. Ind. Hyg. Ass. J. 29, (2), 123-8 (1968).

This paper reports on an investigation of 3 proposed techniques - a piezoelectric crystal sensor, an acoustical sensor, and a hot wire sensing element - and compares their relative merits with each other. It is concluded that the hot wire anemometer appears to offer the most promise for further development, particularly because of its ability to discriminate between solid and liquid aerosols.

398 REYNOLDS, F., Training of local authority staffs in grit, dust and fume measurements. Smokeless Air, 39, (147), 19-24 (1968).

Cost of measurement and of equipment are given, together with a suggested course curriculum, and a description of equipment for sampling dust, grit and fume.

399 RÜPING, G., The influence of isokineticity during dust sampling with probes. Staub 28, (4), 137-44 (1968) (German). Staub 28, (4), 1-11 (1968) (English translation). [Engineering Index 69, 693(1969). Fuel Abstr. 9, 7296, 8921 (1968), 10, 6628 (1969)]

Theoretical evaluation of air currents and particle trajectories at the inlet of sampling nozzles indicate that the importance of isokinetic sampling is overestimated. Other factors such as the number of measuring points in the duct are more important as regards determination of dust concentration.

400 SEILER, P.E., Design for air pollution control - Comparison of source sampling techniques - Stack analysis for sampling. Air Cond. Heat. Vent. 65, (2), 8, 10, 12, (3), 17-21 (1968). [Fuel Abstr. 10, 7470 (1969). Engineering Index 69 (1968)]

Lists the main codes for testing stack effluents, mainly coal combustion products. Disagreements between the codes and how they can be reconciled are considered in relation to standard conditions, number of test points, and test run period.

401 SHORT, W., Grit and dust emission. Simon. Eng. Rev. (11), 6-13 (1968). [Fuel Abstr. 10, 488 (1969)]

Considers types of emission and ways in which it can be measured and controlled. Particular attention is given to the Clean Air Act (1956) and associated legislation. *(Original not consulted.)*

402 STERN, A.C. (editor), Air pollution. Academic Press, New York, 2nd ed., 3 vols. (1968).

Chapter : "Source testing and monitoring" by B.D. Bloomfield, discusses equipment and procedures for sampling and monitoring stack gases.

403 WESTGLADE ELECTRICS CO., "Fordust" smoke and dust monitor. Smokeless Air (147), 61-3 (Autumn 1968). [Fuel Abstr. 10, 8938 (1969)]

Optical density meter described uses back scatter from the smoke or dust particles to measure the material in a duct. This takes advantage of the photoelectric cell's most sensitive range, and, unlike obscuration devices, can be used on wide ducts.

404 ZENKER, P., Evaluation of the measuring error due to anisokinetic sampling during determination of the dust concentration in flowing gases. Tech. Uberwach. 9, (2), 51-2 (1968) (German). [Fuel Abstr. 9, 5813 (1968). Air Pollut. Abstr. 2, (2), 84 (1971)]

This report deals with a new method which allows the determination of measuring errors even in the case of non-isokinetic separation of the partial stream.

1969

405 ANGLESIO, P., Analysis of flue gases from heating plant. Termotecnica 23, (2), 86-9 (1969) (Italian). [Fuel Abstr. 10, 7465 (1969)]

Examines gravimetric and optical methods for measuring concentration of solids emitted in flue gases. Concentration measurements with a sampling probe prescribed by Italian regulations on air pollution from thermal plants and basic principles and difficulties of testing dust separation equipment.

406 BERNERT, J., Recommendations for the installation and operation of stationary measuring and analyzing equipment for controlling the emission of dust and sulphur dioxide. Wasser, Luft. Betr. 13, (2), 39-41 (1969) (German). [Chem. Abstr. 71, 6361f (1969). Fuel Abstr. 11, 6725 (1970)]

This paper discusses measuring techniques, exactitude and reliability of measurements, calculations, reporting of results, and includes an explanation of commonly used terms. *(Original not consulted.)*

407 COENEN, W., Simple flow sensitive arrangement equipped with a thermistor and its technical application for dust measurement. Staub 29, (11), 455-9 (1969) (German). Staub 29, (11), 16-22 (1969) (English translation). [Engineering Index 9, (1), 87 (1970). Fuel Abstr. 11, 4314 (1970)]

The problem of sample volume determination in the case of dust measuring is discussed. An arrangement is described which is particularly suitable for dust measuring instruments. The electric circuit of this arrangement is given and factors influencing the flow sensitive signal are discussed on the basis of the results of measurements.

408 DÜWEL, L., New developments in recording dust measurement of emissions. Paper presented at Congress "Reinhaltung der Luft", 13-17 October, 1969, Dusseldorf. Abs. in Staub 30, (2), 18-9 (1970) (English translation). [Fuel Abstr. 12, 4862 (1971)]

Eight optical smoke density measuring instruments tested previously (see Ref. 378) were retested after modifications. The results show that there is an uncertain relationship between light extinction and dust concentration. Two new dust monitors, one measuring the intensity of light scattering produced by dust particles and the other using the attenuation of beta-radiation to measure the dust content will be tested next.

409 GOLDBERG, A.S. and BOOTHROYD, R.G., Measurements in flowing gas-solids suspensions. Brit. Chem. Eng. 14, (12), 1705-8 (1969), 15, (3), 357-62 (1970).

The first part of this article reviews flowmetering gas-particulate solids suspensions with particular reference to pneumatic conveying. The emphasis of the second part is on taking measurements at a point in the flowing suspension.

410 GOLDSCHMIDT, V.W., Hot wire anemometer as an aerosol droplet size sampler. Atmos. Environ. 3, (6), 643-51 (Nov. 1969).

The device is calibrated for droplets of dibutyl phthalate, Sinco prime 70, and safflower, and shown to give a voltage output proportional to the droplet diameter for drops under 200 microns. This is in agreement with analysis presented. An estimate of largest size droplets to hit wire without shattering and to remain attached without being blown off by the stream is given.

411 GRÜNENDIEK, K. and VOLKERY, J., New pulverized coal measuring instrument and new zero-pressure pendulum probe. Energie 12, 54-7 (Feb. 1969) (German). [Fuel Abstr. 10, 6856 (1969)]

A combination of a scale and zero pressure pendulum probe for isokinetic withdrawal of a sample of pulverized coal and metering the weight of coal passing through a duct in a given time gives better results than any other instrument or arrangement. The duct cross section is usually divided into 24 or 48 measuring points and a withdrawal time of 20 seconds at each is enough. This arrangement can also determine dust in the flue gas.

412 HIMI. Y. and MORI, O., Measurement of dust concentrations in flue gas. V. Studies on sampling points for measurement of dust concentration in a horizontal straight flue. Kogyo Kagaku Zasshi 72, 2347-51 (1969) (Japanese). [Chem. Abstr. 72, 103438q (1970)]

An air flow containing a known concentration of fly ash and talc particles was passed through a horizontal straight model flue, and the distribution of dust concentration measured. An expression is given for the horizontal distribution of dust concentration. *(Original not consulted.)*

413 HOLZHEY, J. and DEMMRICH, J., Radiometric instrument for the continuous control of blast furnace dust. Neue Heutte 14, (4), 198-201 (1969) (German). [Chem. Abstr. 71, 41964b (1969). Fuel Abstr. 11, 8444 (1970)]

The operation of the instrument is described. The results obtained from continuous measurements of blast-furnace dust are given. The monitor is operable with an alpha-ray tube of 10 or 15 Kev. output. The instrument is positioned in the blast furnace gas duct between the dry vent and the dust collector bag. Dust in the gas stream is plotted in g/m^3 against $I/Ig \times 100$ in percent, in which I = intensity of attenuated radiation and Ig = intensity of radiation attenuated in pure air. *(Original not consulted.)*

414 JUNG, R., Vessel probe to measure dust concentration in flowing gases. Chem. Ing. Tech. 41, (10), 620-5 (1969) (German). [Fuel Abstr. 10, 8227 (1969), 11, 1231 (1970)]

Uses a tube subjected to transverse flow with a collector or measuring bore on the line of compression. The dust trapped represents mean values of the dust flow density in the measuring regions.

415 KOLAR, J., Measure of dust content of waste gases. Maschinenmarkt. 75, (81), 1791-5 (1969) (German). Abs. in Pollut. Atmos. 13, (51), 251 (1971)

Review of methods of dust measurement (gravimetric, photometric and radiometric) and their means of sampling (intermittent or continuous). *(Original not consulted.)*

416 KOLAR, J., The electrostatic dust content measuring instrument "Konitest" and its use in a power station. Tech. Uberwach. 10, (6), 188-90 (1969) (German). Abs. in Pollut. Atmos (49), 81 (1971)

This article describes the application of the "Konitest" electrostatic dust monitor which is in operation in a power station burning bituminous coal and producing a large amount of dust.

417 KRAUSE, U. and WASILEWSKA, J., Investigations of dust and sulphur dioxide emission into the air from various departments of steelworks. Hutnik. 36, (3), 128-32 (1969) (Polish). [Fuel Abstr. 11, 1941 (1970)]

Method of measurement and results. *(Original not consulted.)*

418 KURFURST, J., Methods for determination and control of solid emissions. Ochr. Ovzdusi (Air protection) 1, (7), 102-112 (1969) (Czech.).. [Fuel Abstr. 11, 8399 (1970)] *(Original not consulted.)*

419 LANG, N., Process for continuous gravimetric determination of dust emission. Staub 29, (3), 123 (1969) (German). Staub 29, (3), 44 (1969) (English translation). [Chem. Abstr. 71, 33170z (1969)]

In the process described, a fraction of the gas stream is sampled and passed through a 10 Kv precipitator in which the dust is deposited on moving foils. The thickness of the deposited layer is measured by beta-back scattering from a ^{14}C source (see Ref. 385.)

420 LARSSON, O., The measurement of solids in flue gases. Tidsskr. Vaerme. Ventilations-, Sanitets-Och. Kylteknik (Stockholm), 60, (9), 509-11 (1969) (Swedish). [Air Pollut. Abstr. 2, (2), 7 (1971)]

A review of stack sampling with a discussion of the accuracy. *(Original not consulted.)*

421 LAUFHÜTTE, D.W., Practical experience with dust recorders for continuous control of dust emissions. Mitt. Ver. Grosskesselbesitzer. 49, (1), 15-23 (Feb. 1969) (German). [Fuel Abstr. 10, 7467 (1969). Engineering Index 69, (1), 845 (1970)]

Survey of two dust recorders for monitoring dust emissions from industrial plants. One operated on the extinction principle and the other was an electrostatic instrument. It was found that in the case of instruments which measure dust concentration of the whole flue gas stream, there exists a reliable relation between dust concentration and value indicated by monitor. *(Original not consulted.)*

422 LANGEJAN, J.D., Description and operating instructions of the CSIR sampling equipment for isokinetic sampling of dust laden gas. CSIR (Counc. Sci. Ind. Res., S. Afr.) Special Report Chem. 123, 26 pp (Dec. 1969). [Fuel Abstr. 11, 8443 (1970)]

This report serves as a detailed record of the numerous components of the CSIR dust sampling equipment, as well as being a guide to the operation of the equipment. As such, it is intended mainly for internal use, but the detailed sketches may be used by interested organisations for manufacturing their own equipment.

423 OLSSON, S., Measuring methods for the quantitative measurement of solid particles in flue gases. Tidsskr.Vaerme. Ventilations-, Sanitets-Och. Kylteknik (Stockholm) 40, (3), 149-61 (1969) (Swedish). [Air Pollut. Abstr. 2, (3), 63 (1971)]

Review of methods and instruments used in dust sampling and monitoring. *(Original not consulted.)*

424 OPARYSHEVA, V., Instrument for the continuous measurement of the dust content of air and gases. Metallurg. (Moscow) 14, (6), 44-5 (1969) (Russian). Metallurgist (USSR) (5-6), 390-1 (1969) (English translation). [Pollut. Atmos. 12, (48), 286 (1970). Air Pollut. Abstr. 2, (2), 88 (1971)]

A description is given of three variations of the "Konitest" apparatus with details of principle of operation and of construction. Examples are given of application to the measurement of dust in blast furnace gas before and after cleaning. *(Original not consulted.)*

425 SANSONE, E.B., Sampling airborne solids in ducts following a 90^o bend. Amer. Ind. Hyg. Ass. J. 30, (5), 487-93 (1969). [Fuel Abstr. 11, 3648 (1970)]

Measurements of 25 micron glass sphere particle concentration were made in the horizontal duct at 1, 2, 4, 8 and 16 duct diameters downstream of a 90° bend for air velocities of 1,2 and 2,4 m/s (measured at the centre line in the horizontal run of duct) radii of curvature of the elbow 2 and 4 times the duct diameter, and 12 sampling points at each cross section (4 points along each of 3 diameters, one diameter in the bend plane the others at 60° to the first).

426 SOO, S.L., STUKEL, J.J. and HUGHES, J.M., Measurement of mass flow and density of aerosols in transport. Environ. Sci. Technol. 3, (4), 386-93 (1969). [Fuel Abstr. 11, 1230 (1970)]

In this investigation the filtration method was used for measuring the particle flux, while the attenuation of light passing through a suspension was used for monitoring the particulate cloud density. This optical system is an improved form of the earlier fibre optic probe. Measurements were carried out in a 12 x 12 inch flow duct for various suspensions in air. Flow into a channel formed by parallel plates in this duct was studied.

427 TAMORI, I. and SHIRASAWA, T., Collection efficiency of dust samples for measurement of dust content in stack gas. Kogai (Hakua Shobo) (Pollution Control) 4, (4), 44-7 (1969) (Japanese).

The use of a filter packed with glass wool is prescribed for measuring the dust contentration in stack gases in the Japanese Standard JIS Z 8808. In addition it is stated that the filter must retain 99 % of the particles in the sampled gas. This paper describes experiments done to ascertain the collection efficiency of the air filter under various conditions. A relationship is established between collection efficiency and particle diameter for a given gas velocity, fibre diameter and depth of filter. *(Original not consulted.)*

428 VETTER, H., Comparative long duration trials of dust concentration recording instruments in flue gases of brown coal-fired power plants. Mitt. Ver. Grosskesselbesitzer. 49, (1), 23-7 (1969) (German). [Engineering Index 69, (1), 845 (1970). Fuel Abstr. 10, 7468 (1969)]

In three brown coal power stations eight photometric flue gas dust recorders were tested over three months and subjected to initial and final gravimetric calibration. No instrument was reliable in continuous operation. The reasons are discussed.

1970

429 Anon, Aircraft gas turbine engine exhaust smoke measurement. Aerospace Recommended Practice, ARP 1179, 8 pp, (May 4, 1970). [Air Pollut. 2, (3), 64 (1971)]

Procedures and sampling probes are described for determining and reporting the amount of smoke emission from an aircraft gas turbine engine.

430 Anon, Basic technology. Chem. Engng. (New York) 77, (9), 165-72 (Apr. 27, 1970).

Brief description of particulate sampling is given.

431 Anon, Improved National Coal Board apparatus for measuring flue gas dust concentrations. Steam Heat. Eng. 39, (459) 12-14 (Feb. 1970). [Fuel Abstr. 11, 6702 (1970)]

A sampling apparatus is described which uses a small high efficiency tangential flow cyclone within the probe head without a backing filter. It is primarily intended for use in measuring grit and dust emissions from industrial coal fired boiler plants.

432 BALL, D.F. and GRIFFITHS, D.L., Measurement of dust concentration and size in ducts and chimneys. Environ. Health 78, (12), 561-6 (1970), 79, (1), 10-16 (1971). [Fuel Abstr. 12, 9269 (1971). Air Pollut. Abstr. 2, (6), 81 (1971)]

Describes isokinetic sampling; sampling site; B.C.U.R.A. cyclone probe and conventional sampling train. An example is given showing the necessary calculations.

433 BARABOOKHINA, G.K. and MONASTYREV, A.V., Determination of the dustiness of exhaust gases from industrial lime kilns. Sb. Tr., Gos. Vses. Nauch. - Issled. Inst. Stroit. Mater. Konstr. 18, 132-8 (1970) (Russian). [Chem. Abstr. 74, 145995 (1971)]

An instrument for the determination of the dust content of gases is described. It consists of an intake tube, electric heating unit, receptacle with filtering sleeve, rheometer, a vacuum pump, oil trap, electric motor, and a step down transformer. Results of tests performed at the Belgorodsk combine are given. *(Original not consulted.)*

434 BAUM, F., Examination of emissions from furnaces for solid fuels in the framework of the immission protection law of Nordrhein-westfalen. Staedteh. 21, (12), 254-8 (1970) (German). [Chem. Abstr. 74, 115,520 (1971)]

Methods developed for measurement of emissions from domestic fuel stoves and central heating units utilising solid fuels are described. Automatic measurements of dust, soot and tar emissions are described. *(Original not consulted.)*

435 BENARIE, M. and PANOF, S., Notes on aerosol samples taken from a turbulent gas stream at the gas flow rate. Battelle Inf. (8), 47 (Nov. 1970). [Fuel Abstr. 12, 6238 (1971)] *(Original not consulted.)*

436 BENARIE, M. and PANOF, S., Notes on solid particulate sampling from a turbulent gas stream. J. Aerosol Sci. 1, (1), 21-33 (1970) (French).

Describes experiments carried out on sampling polydisperse dust particles up to 4 micron diameter. The particles were blown down a vertical wind channel and sampled with elongated, hemispheric and flat nozzles at velocities equal to 0,5; 1,0 and 2,0 times the main stream velocity. The relationship between the ratio of the apparant to true concentration and the ratio of the sampling to main stream velocities were found to agree with the expression of Vitols (Ref. 285 and 301). It is essential to sample isokinetically to obtain correct values for the concentration. The error is smaller when the sampling velocity is too high than in the opposite case. The shape of the head was not important and changes in the particle size distribution due to sampling anisokinetically could not be detected.

437 BIGNARDI, L. and MASTROLILLI, M., Solid emissions in flue gases from combustion processes. Termotecnica 24, (2), 99-104 (1970) (Italian). [Fuel Abstr. 12, 1484 (1971)]

Describes a method of sampling using the Shell carbon determination apparatus. *(Original not consulted.)*

438 BRANDON, J.H., Measurement of particulate emissions. Ind. Coal Conference, Purdue Univ., Lafayette, Ind., 16 pp (Oct. 7-8, 1970). [Engineering index 9, (6), 95 (1971)]

This article describes the referee type method for particulate measurement and identification which provides an overall accuracy of 95 % or more. The major drawback of this method is the time required to conduct a test and the difficulty in automating. However, used as a periodic check on methods that are easily conducted and automated, and to extablish operating parameters, this method provides the necessary backup for demanding results. *(Original not consulted.)*

439 CROSS, F.L. and HIGGINS, F.B., Source testing for particulates. Bldg. Systems Design 67, 8 (Oct. 1970).

Describes several sampling trains, and techniques. Gives manpower requirements and estimate of cost.

440 CUFFE, S.T. and BIXBY, W.F., Atmospheric emissions from wet process phosphoric acid manufacture. U.S. Dept. Health Education and Welfare. Publication No. AP-57, 86 pp (1970). [Chem. Abstr. 73, 28555 (1970). Fuel Abstr. 12, [illegible]385 (1971)]

A summary of sampling and analytical techniques is given on p 35-36, and 57-69. The equipment used was as described in Reference 368. The basic measurements performed during this sampling were of effluent flow, and gaseous and particulate fluoride concentrations. Sampling was performed isokinetically along a representative traverse of the stack. Selection of sampling points, sampling time and equipment costs are discussed.

441 DRESIA, H. and SPOHR, F., Experience with radiometric dust measuring unit "Beta staubmeter". Staub. 31, (6), 1-10 (June 1971). [Particle Sci. Tech. Inf. Ser. (5), (Jan. 1971)]

442 DRESIA, H. and SPOHR, F., Radiometric measuring of dust emission in cement, metallurgical and electrical plants. Ochr. Ovzdusi 2, (12), 186-91 (1971) (Czech.). [Chem. Abstr. 75, 24819y (1971)]

A device manufactured by the firm Verewa, FRG, and the results of trial measurements in the plants mentioned are described. The device works quasi-continuously and is suitable for all sorts of dust. It is calibrated easily in the laboratory. The gas can be sampled either at one point or by a circular probe. In contrast to other devices, the dust samples on the filter can be used for further analysis. The device described is principally suitable for the determination of emissions. *(Original not consulted.)*

443 DÜWEL, L., Comparative investigations of different measuring principles for continuous monitoring of dust emissions of lignite fired steam boilers. Presented at the Int. Clean Air Cong., 2nd Washington, D.C., Dec. 6-11, 1970. Paper CP-19F. Preprint, International Union of Air Pollution Prevention Associations, 60 p, 1970. [Air Pollut. Abstr. 2, (4), 71 (1970)]

Describes, theory, tests and construction on 4 optical instruments operating with transillumination system and one using the intensity of light scattering produced by grain particles to monitor dust emissions. An additional test was done on an apparatus using the attenuation of beta-radiation by dusted filter paper. Their reliability and stability is discussed. Comparative measurements made with discontinuous gravimetric samplers showed a statistically secured relationship between indicated value and gravimetric dust content. *(Original not consulted.)*

444 EICKELPASCH, D., Automation of the conventional gravimetric dust measuring method for quasi continuous following the cause of processes. Presented at the Int. Clean Air Congress, 2nd, Washington D.C., Dec. 6-11, 1970. Paper CP-19G. Preprint, International Union of Air Pollution Prevention Associations, 16 p, 1970. [Air Pollut. Abstr. 2, (4), 68 (1971)]

A system is described for monitoring continuously changing dust content in waste gases from intermittent industrial processes. In this system gravimetric short time dust measurements are obtained in a multichamber device that is partly automated by means of magnetic valves and electric short time meters and provided with strictly synchronous measuring point control. The construction of a special solenoid valve operated control block allows further automation, such as complete remote control of one or more measuring points. Accuracy of the device is high, even on short running processes with very short measuring intervals. *(Original not consulted.)*

445 ELS, C.J., The measuring of air pollution by dust from a fertilizer factory. M.Sc. Thesis (Industrial Chemistry), Potchefstroom University, 127 pp, (March 1970).

The extent of air pollution by dust was determined at the granulation plant and the mill section of a fertilizer industry. During all the tests at the granulation plant superphosphatic fertilizers were produced. The equipment used, was the CSIR dust sampling equipment which was developed by the Chemical Engineering Group of the Council.

446 GAJDA, S. and RYSZKA, E., Iso and anisokinetic measurements of dust content of combustion gases. Ochr. Poviet. 19, (5), 22-5 (1970) (Polish). [Fuel Abstr. 12, 6290 (1971)]

Measurements of dust content of combustion gases arising from a sinter belt were carried out by iso- and aniskoinetic sampling of dust carrying gases with a probe. The method used for measuring the dust content of these gases is described and the results obtained are given. *(Original not consulted.)*

447 IZMAILOV, G.A., KAGANOV, V.Y. and STARK, S.B., Automatic control of the weight concentration of dust in gases. Izv. Vyssh. Ucheb. Zared., Chern. Met. 13, (8), 163-5 (1970) (Russian). [Chem. Abstr. 73, 13245r (1970)]

The control method described is based on the continuous filtration of flue gases and continuous scanning of the filtered layer, positioned next to a beta-radiation source with a scintillation counter. It is based on the fact that beta-radiation absorption depends only slightly on the atomic weight of the flue gas components. Flue gas component agglomeration in the filter is an integral process, and to obtain instantaneous concentration values differentiation is necessary. Diagrams are given of a continuous analog-type differentiating device, and of such a device with a cathode follower. The second type gives a signal of about 30 mV at 100 ohms with a ± 5 % fluctuation when changing the input signal by 6 V/h. *(Original not consulted.)*

448 JACKSON, M.R., LIEBERMAN, A., TOWNSEND, L.B. and ROMANEK, W., Prototype fly ash monitor for municipal incinerator stacks. Proc. National Incinerator Conf., Cincinnati, Ohio, p 182-8, 1970. [Air Pollut. Abstr. 2, (4), 78 (1971)]

This paper describes construction details and tests of a prototype instrument having capabilities for automatic isokinetic and manually selected sampling, remove assessment of fly ash contained in a measured mass of gas, selective frequency of sampling, and remote control and readout capabilities. *(Original not consulted.)*

449 MAURER, O. (Siemens A.-G.), Apparatus for measuring light absorbing substances in fluids, especially suspended particles in gases. Ger. Pat. 1,942,942 (March 26, 1970). [Chem. Abstr. 72, 134543z (1970)]

In the photometric instrument described the concentration of suspended particles, x, in a gas is measured as a function of variations in light intensity, ΔI, while maintaining a constant light source I. *(Original not consulted.)*

450 NAGAMI, Y., Problems on measurement of the concentration of particulate contaminants in smoke dust. Bunseki Kiki (Analysis Instr.) 8, (8), 528-35 (1970) (Japanese). [Air Pollut. Abstr. 2, (3), 83 (1971)]

The selection of sampling points and the location of the ports is discussed and dust sampling probes are described. *(Original not consulted.)*

451 RAYNOR, G.S., An isokinetic sampler for use on light aircraft. NAPCA Grant AP-81, BWL-15374, 17 p, 1970. [Air Pollut. Abstr. 2, (4), 85 (1971)]

The design and operation of a light aircraft mounted isokinetic sampler is described. It was developed for obtaining accurate samples of heterodisperse particulate matter in the lower atmosphere. *(Original not consulted.)*

452 SCHNITZLER, H., Investigation into the suitability of recording instruments for the measurement of dust concentration in flue gases. Gesundheit-Ing. 90, 307-9 (1969). Abs. in Staub 30, 173 (1970).

The accuracy of four dust monitors are compared, two of which operate on the light extinction principle, one on contact electricity and one on the attenuation of beta radiation.

453 SEHMEL, G.A., Particle sampling bias introduced by anisokinetic sampling and deposition within the sampling line. Amer. Ind. Hyg. Ass. J. 31, (6), 758-71 (1970).

Particle sampling errors from several sources were studied with monodisperse aerosol particles. The sources of errors investigated were the influence of inlet probe diameter on isokinetic samples, the turbulent deposition of particles in straight tubes and one elbow configuration and non-isokinetic sampling. The sampling errors were shown to be significant for particles as small as 1 micron in some cases. A particularly significant observation was that non-uniform concentration in the conduit sampled can cause serious errors. Some studies of the particle concentration profiles in a 3 inch tube showed that particles in many cases are concentrated in a narrow annulus near the wall making representative sampling nearly impossible for these cases.

454 SHIGEHARA, R.T., TODD, W.F. and SMITH, W.S., Significance of errors in stack sampling measurements. Presented at the Air Pollution Control Association Annual Meeting, 63rd, St. Louis, Mo., June 14-19, 1970. Preprint, Air Pollution Control Association, New York City, 27 p, 1970. [Air Pollut. Abstr. 2, (3), 83 (1971)]

Maximum errors in terms of individual measurements conducted in stack sampling are considered for two specific examples: velocity measurement using the Pitot tube, and a sampling train utilizing a Pitot tube and an orifice meter to attain isokinetic conditions. By partial differentiation of the Pitot tube equation and the isokinetic sampling train equation, the relative order of magnitude of errors are determined. *(Original not consulted.)*

455 SHORT, W., The Clean Air Act: The measurement of grit and dust emissions. Proc. Clean Air Conference, Southport Oct. 20-30, 1970. [Fuel Abstr. 12, 6334 (1971)]

The National Industrial Fuel Efficiency service has carried out about 700 tests to determine grit and dust from a wide variety of boiler and furnace plants. This paper discusses the problems that have arisen with the particular type of plant tested and shows how these have in most cases been overcome. The author gives a summary of a typical 3 day course available using the B.C.U.R.A. cyclone probe as demonstration test equipment.

456 SMITH, N.S., Jr. and FASCHING, G.E., Electrodynamic application to dust monitoring. Presented at the International Clean Air Congress, 2nd, Washington, D.C., Dec. 6-11, 1970. Paper CP-19E. Preprint, Int. Union of Air Pollution Prevention Associations, 17 p, 1970. [Air Pollut. Abstr. 2, (4), 73 (1971)]

Electrogasdynamic principles were investigated as the basis for a continuous monitor of size and mass flow of dust in a gas stream. Theory construction details and results of experiments done with an instrument using this principle are discussed. *(Original not consulted.)*

457 STÖNNER, A., SCHNEIDER, A. and KÖNIG, W., Measurement of coal dust concentration in pipelines using radioactive isotopes. Mitt. Ver. Grosskesselbetr. 50, (2), 100-4 (1970). [Chem. Abstr. 73, 82908w (1970)]

A method for measuring the transport of coal dust in pipelines is described. It utilises 80_mCi ^{90}Sr beta-source and a 10-atm Ar ionization chamber as detector.

458 TAMORI, Y. and SHIRASAWA, T., On measurement of dust density in smoke exhaust duct. Kogai (Hakua Shobo) (Pollution Control) 5, (5), 32-41 (1970) (Japanese). [Air Pollut. Abstr. 2, (4), 77 (1971)]

Discusses measurement of dust density in a smoke exhaust duct as described in the Japanese standard. Method and calculations are reviewed in detail. Recommendations are made for the selection of the test site. *(Original not consulted.)*

459 UETAKI, T., On the measurement of particulates. Sangyo Kogai 5, (7), 19-27 (1970) (Japanese). [Air Pollut. Abstr. 2, (4), 64 (1971)]

A detailed explanation is given of sampling particulates in exhaust gases according to N.I.S. 8808 "Measurement method for particulates in flue gas". *(Original not consulted.)*

1971

460 BERNERT, J., Emission monitoring by approved measuring and analytical instruments. Wasser, Luft Betr. 15, (4), 123-7 (1971) (German). [Chem. Abstr. 75, 52452 (1971)]

Description, functioning and illustration of two photometric instruments officially approved in West Germany for monitoring dust or smoke in industrial waste gases is given.

461 BOUBEL, R.W., A high volume stack sampler. Presented at the 64th Annual Meeting Air Pollution Control Association, Atlantic City, New Jersey, (June 27, July 1, 1971). *(Original not consulted.)*

462 BÜNZ, P., Causes, measurement and limitation of solids emission from oil fired boilers. V.G.B. Conference on Emissions, Hannover, 20 pp, Feb. 1971 (German). [Fuel Abstr. 12, 9298 (1971)]

Discusses causes and type of solids emission (fly ash, soot, cake type solids), factors that influence formation of pollutants, sampling and analysis, reduction of emission and air pollution legislation. *(Original not consulted.)*

463 CARR, J.F. and JARMAN, R.T., Techniques for measuring solids concentration in chimney gases from oil fired power stations. J. Inst. Fuel 44, (360), 33-37 (1971)

Two filter methods for measuring the concentration of particles in chimney gases at oil fired power stations are described, together with two impaction techniques yielding particle size distribution. The latter also yield an estimate of the volumetric concentration of solids. Some limitations of the method are mentioned. The results obtained in tests at four plants are given. These illustrate the application of the method, and indicate the low particulate concentration present in the flue gases.

464 COOPER, H.B.H. and ROSSANO, A.T., Source testing for air pollution control. Environmental Science Services Div., Enviromental Research and Applications, Inc., Winton, Conn. 229 p, (1971). [J. Air Pollut. Contr. Ass. 21, (7), 433 (1971)]

A detailed presentation is made of measurements of gas flow, sampling trains for gaseous pollutants, methodology, principles, and sampling trains for particulate pollutants. The emphasis is placed on stationary sources of gaseous and particulate pollutants. *(Original not consulted.)*

465 DORSEY, J.A. and BURCKLE, J.O., Particulate emissions and process monitors. Chem. Eng. Prog. 67, (8), 92-96 (1971).

Reviews properties of particulates and characteristics of solid dispersions in gas streams. Particulate sampling is discussed and the errors associated with it, such as those caused by anisokineticity, yaw, nozzle size and deposition in probe are mentioned. The process monitors reviewed are those depending on the attenuation of light, sound and radiation, and operating on the principle of the electrobalance and electrostatic monitors.

466 GOLOVATYUK, V.M. and YURENEV, V.N., Entrainment distribution in turbulent flows of high temperature gases. Teplo energetika, 18, (1), 81-4 (1971) (Russian). Therm. Eng. (USSR) 18, (1), 122-6 (1971) (English translation). [Chem. Abstr. 74, 55681 (1971)]

Hot combustion gases from solid fuel fired metal smelting operations were analyzed for turbulent flow of solids size, and solids concentration distribution. Distributions of concentrations of suspensions were obtained by means of simultaneous isokinetic sampling at several points of the cross section.

467 HICKS, R.E., Measurement techniques and systematic errors in sampling dust laden gas streams. CSIR (Counc. Sci. Ind. Res., S. Afr.) Special Report Chem 188, 25 pp (1971).

Industrial dust sampling should be done with the least costly procedure compatible with the desired accuracy. On this basis it was found that the cumulative sampling technique is adequate for "steady" emissions provided that the location of the representative points allows for the velocity decay at the wall. Non steady emissions require multipoint samples with simultaneous reference samples. In this case data processing may be by an available computerised surface fitting procedure.

468 HUDSON, A.E. and BOUBEL, R.W., Sampling of emissions from a mobile agricultural incinerator. Presented at the 64th Annual Meeting of the Air Pollution Control Association, Atlantic City, New Jersey, (June 27 - July 1, 1971). *(Original not consulted.)*

469 KRAUSE, U., *et al*, Dust and sulphur dioxide emission from the shaft furnace plant at Kosciuszko Works. Ochr. Powiet. (1), 12-16 (1971) (Polish). [Fuel Abstr. 12, 9287 (1971)]

This paper gives a method for the determination of dust and SO_2. Some of the physical/chemical properties of the dust are discussed. *(Original not consulted.)*

470 MARTIN, R.M., Construction details of isokinetic source sampling equipment. Environmental Protection Agency Research, Triangle Park, N.C. Air Pollution Control Office, 35 p, 1971.

This report was prepared in order that interested persons in local air pollution agencies might build their own isokinetic source sampling equipment. This equipment was designed and has been used since 1967 by employees of the U.S. Environmental Protection Agency's Air Pollution Office (APCO). In a field test, the equipment was run for 24 hour periods without encountering any malfunctions. The construction details include : The meter box; umbilical cord; sample box with glassware; probe; and calibration procedures for the orifice and meter.

471 RAO, C.S. and DUKLER, A.E., The isokinetic-momentum probe. A new technique for measurement of local voids and velocities in flow dispersions. Ind. Eng. Chem. Fundam. 10, (3), 520-6 (1971).

This paper presents an experimental technique for measurement of local phase velocities and local solids concentration in a dispersed gas-solid flow stream. The method is based on the use of a suspended pitot type sampling tube which responds to forces acting on it due to drag pressure and a change in momentum as the two phase stream makes a 90° change in direction. This force is measured with transducer located external to the test section. Criteria for operating the sample probe under isokinetic conditions are discussed and typical experimental data are presented.

472 ROUILLARD, E.E.A., Experimental errors in sampling dust laden gas streams. CSIR (Counc. Sci. Ind. Res., S. Afr.) Special Report Chem 189, 21 p, (1971).

The errors resulting from faulty design and operation of the equipment are reviewed. Their magnitude is shown to depend on the type of sampling equipment as well as on the flow characteristics. Some of the factors contributing to the error are non random under fixed conditions and therefore cannot be eliminated by increasing the number of measurements. A major source of experimental error results from anisokinetic sampling.

473 SEM, G.J., BORGOS, J.A., OLIN, J.G., PILNEY, J.P. and LIU, B.Y.H., State of the art : 1971. Instrumentation for measurement of particulate emissions from combustion sources. Volume 1 : Particulate mass summary report. Thermo-Systems, Inc., St. Paul Minn., 194 p, (1971).

All known sensing techniques available for application to automatic, continuous measurement of the rate of particle mass emissions from large fossil-fuel combustion facilities are discussed. A list of inherent and practical strengths and weaknesses of each technique is given.

474 SEM, G.J., BORGOS, J.A. and OLIN, J.G., Automatic monitors of particulate mass emissions from stationary fossil fuel combustion sources. Am. Inst. Chem. Eng. 68th National Meeting Houston, Texas, March 3, 1971, Paper 68d. *(Original not consulted.)*

475 SERPER, A., A look at the methods for measuring air pollutants. Eng. Mining J. 172, (4), 124-8 (1971).

Sampling for gas and particulate emissions is reviewed. The selection of the sampling site, the number of points sampled and the importance of isokinetic sampling are discussed. The various media available for filtering dust from the gas sample are mentioned. These include alundum, paper, glass cloth and membrane filters. Continuous monitoring systems are reviewed, these include photometric and bolometric monitors as well as those collecting the dust sample on a tape filter before measurement.

476 SJOGREN, A., New equipment for measuring particle concentrations in flue gases. Vaerme 36, (2), 23-8 (1971) (Danish). [Fuel Abstr. 12, 9288 (1971)]

Describes the equipment which uses a cyclone to separate the particles into oil cokes (cenospheres) which are collected in the cyclone, and soot particles which pass through the cyclone for subsequent determination by the smoke number method. The high measurement rate is obtained by including a backing filter after the cyclone as the weight of the soot particles is very small. *(Original not consulted.)*

477 STOCKMAN, J.D., The composition of glass furnace emissions. J. Air Pollut. Contr. Ass. 21, (11), 713-5 (1971)

A sampling train for measuring particulate emissions from glass furnaces is described. The probe is a Vycor glass tube encased in an aluminium sheath. The inlet is one inch in diameter. A Teflon filter is used to collect the particulate matter as glass fibres would be inappropriate for investigating effluent from glass furnaces. Ceramic thimbles were considered too coarse to retain the ultra fine particles evolved.

478 ZENKER, P., Investigations into the problem of sampling from a partial flow with different flow velocities for the determination of the dust content in flowing gases. Staub 31, (6), 252-6 (1971) (German). Staub 31, (6), 30-6 (1971) (English translation). [Particle Sci. Tech. Inf. Ser. (5) (Jan. 1972)]

Describes tests carried out to determine magnitude of error caused by anisokinetic sampling and discusses corrections to be applied.

1972

479 LUCAS, D.H., SNOWSILL, W.L. and CROSSE, P.A.E., The continuous monitoring of particulate emissions. Measurement Control 5, (1), 9-19 (1972)

Describes instrument for monitoring smoke and fine dust emissions from combustion of fuel. Inaccuracies of optical instruments and means of minimizing errors are discussed. The Everclean Window is described together with the automatic use of purging air to record the effective instrument zero. Coarse dust is measured using the C.E.R.L. flue dust monitor.

480 MORROW, N.L., BRIEF, R.S. and BERTRAND, R.R., Sampling and analyzing air pollution sources. Chem. Eng. 79, (2), 84-98 (1972)

Recommendations are made for selecting sampling sites and for proper sampling techniques. The Environmental Protection Agency (EPA), Los Angeles Air Pollution Control District (LAAPCD) and Bay Area Air Pollution Control District (BAAPCD) particulate sampling trains and several null probes of various configurations are described.

3 AUTHORS INDEX

A

ACHINGER, W.C. 331
ACKLEY, C. 121
AIR FLOW DEVELOPMENTS LTD. 371
ALLNER, W. 5, 6
AMERICAN INDUSTRIAL HYGIENE ASSOC. 209
AMERICAN SOCIETY OF MECH. ENGRS. 41, 129
ANDERSON, D.M.A. 133
ANDERSON, E. 34
ANGLESIO, P. 405
APPLEGATE, J.E. 60
ARBOGAST, A.H. 49, 52
ASKANIA-WERKE, A.G. 9
AVY, A.P. 91, 266

B

BADZIOCH, S. 75, 157, 170, 194, 224
BALDAUF, P. 320, 321
BALL, D.F. 432
BALL, P. 123
BALLMAN, H.C. 61
BAL'SON, B.F. 25
BAMBERG, C. 9
BARABOOKHINA, G.K. 433
BARKOV, N.N. 214
BARTH, W. 131
BATTISTON, M.N. 215
BAUM, F. 336, 337, 434
BEAN, R.D. 20
BEATTY, K.O. 54
BEGAND, H. 299
BEINE, H. 336
BENARIE, M. 266, 267, 338, 435, 436
BERNERT, J. 339, 340, 406, 460
BERTRAND, R.R. 480
BEST, P.F. 55
BIGNARDI, L. 437
BIXBY, W.F. 440
BLACKETT, J.H. 75, 157, 224
BLINOV, K.A. 27
BODIN, D. 288, 338
BOHNET, M. 341
BOOTES, R.L. 270
BOOTHROYD, R.G. 342, 409
BORGOS, J.A. 473, 474
BOUBEL, R.W. 461, 468
BRADY, W. 1
BRANDON, J.H. 438
BREDL, J. 62

BREITLING, K. 87, 143, 170, 195
BREUER, W. 289
BRIEF, R.S. 480
BRINK, J.A. Jr. 155, 244, 268
BRITISH STANDARD INSTITUTION 40, 216
BUBAR, H.H. 44
BUDZINSKI, K. 305
BUISSON, M.P. 269
BUKER, D. 343
BULBA, E. 290, 390
BÜNZ, P. 462
BURCKLE, J.O. 465
BURGESS, W.A. 397
BURKE, E. 101, 132
BUSHMELEV, V.A. 228
BYERS, D.F. 128

C

CADLE, R.D. 122
CALAME, H. 56
CALDWELL, W.E. 26
CALVERT, S. 356
CARDER, B.M. 73
CARLISLE, S.S. 78
CARR, J.F. 463
CENTRALWERKSTATT-DESSAU 9
CHAKKO, M.K. 255
CHASICK, A.H. 270
CHIBA, M. 241
CLARENBURG, L.A. 264
COENEN, W. 256, 271, 344, 407
COLLINS, K.E. 217
COOLIDGE, J.E. 63
COOPER, H.B.H. 373, 464
CORRIGAN, T.E. 66
CROSS, F.L. 439
CROSSE, P.A.E. 218, 219, 220, 479
CUFFE, S.T. 440
CUTTING, K.R. 345
CZERWONKA, L.V. 119

D

DAVIDSON & CO. LTD. 11
DAVIDSON, R.A. 114
DAVIES, C.N. 346, 374, 375
DAVIES, I. 272
DEAS, J.E. 54
DEBRUN, G. 347
DELANGE, J.E. 348, 376
DEMMRICH, H. 413

DENNIS, R. 69, 92, 133
DENZEL, P. 306
DESHKIN, V.N. 27
DEVORKIN, H. 257
DIOR, E. 307
DIXON, W.S. 221
DONSON, J.J. 57
DORLEYN, M. 134
DORSEY, J.A. 377, 465
DOUEZ, F. 116
DOYLE, A.W. 108, 171, 172
DRESIA, H. 273, 308, 441, 442
DREW, W.N. 2
DRINKER, P. 7, 72, 93
DUKLER, A.E. 471
DURST, D.E. 368
DÜWEL, L. 378, 408, 443

E

EDOUARD, L. 222
EHRENFELD, J.R. 172, 229
EHRMANTRAUT, H.C. 122
EICKELPASCH, D. 379, 444
ELS, C.J. 445
ENGDAHL, R.B. 260
ENGEL, J. 43, 196
ETTERICH, O. 258
EVANS, E.C. 73

F

FAHRENBACH, W. 16
FAITH, W.L. 173
FASCHING, G.E. 455
FEIFEL, E. 102, 122, 135, 136, 174, 175, 238
FELDEN, G. 273
FELDMAN, W. 8
FIRST, M.W. 69, 72, 92
FISCHOETTER, P. 273, 308
FITTON, A. 46, 70, 71
FLUX, J.H. 380
FRANZKY, U. 309
FRIEDLANDER, S.K. 72
FUCHS, N.R. 274
FUDURICH, A.P. 125
FUKUNAGA, S. 241

G.

GAJDA, S. 446
GALLAER, W.R. 137

GAST, T.H. 138, 176, 197, 198, 223, 310, 343
GIBBS, W.E. 22
GIEVER, P.M. 362
GILLI, P. 177
GOLDBERG, A.S. 409
GOLDSCHMIDT, V.W. 291, 410
GOLOVATYUK, V.M. 466
GOODALE, T.C. 73
GORDON, D. 311
GRANT, J. 32
GRANVILLE, R.A. 123, 140, 179
GREINACHER, H. 35
GREEN, H.L. 275
GREENE, M. 178
GRIEVE, T.W. 62
GRIFFITHS, D.L. 432
GRIFFITHS, J.H. 37
GRINDELL, D.H. 199, 239
GROBLI, W.A. 12
GROUTSCH, E.R. 180
GRÜNENDIEK, W. 411
GUSSMAN, R.A. 311
GUTHMANN, K. 23, 74, 103, 124, 181

H

HAALAND, H.H. 381
HAASE, W. 382
HABEL, K. 383
HAGER, C.B. 368
HAINES, G.H. 83, 94, 95
HARDIE, P.H. 28, 33
HARRIS, F.J. 156
HARVEY, R.A. 182
HASENCLEVER, D. 200
HATCH, T. 93
HAWKSLEY, P.G.W. 75, 157, 224
HEMEON, W.C.L. 83, 84, 94, 95, 139
HEMINGWAY, A.J. 4
HENDRICKSON, E.R. 183
HEYNE, L. 349
HICKS, C.E. 350
HICKS, D. 351
HICKS, R.E. 384, 467
HIGGINS,F.B. 439
HIMI, Y. 412
HØJERGAARD, F. 312
HOLDEN, F.R. 121
HOLTON, W.C. 85
HOLZHEY, J. 413
HORN, W. 306, 352, 385
HORSMAN, H.S. 96
HOSEY, A.D. 128
HUBBARD, E.H. 141

HÜBEL, E. 201
HUDSON, A.E. 468
HUGHES, J.M. 426
HUNT, M. 240
HYLAND, R.G. 368

I

IBING, R. 150, 242
IINOYA, K. 104
INSTITUT NATIONAL DE RECHERCHE CHIMIQUE APPLIQUÉE 292
IZMAILOV, G.A. 159, 184, 225, 226, 447

J

JACKSON, M.R. 448
JACKSON, K. 140, 160, 185, 202
JAFFREY, W.G. 179
JARMAN, R.T. 463
JANOTT, H. 340
JENKER, E. 3
JOCHEMS, J. 386
JOHNSON, G.A. 69
JOHNSON, H.C. 86
JOHNSON, K.R. 132
JONES, T.D. 37
JUNG, R. 414

K

KAGANOV, V.Y. 446
KAHNWALD, H. 258, 313, 387
KANE, L.J. 66, 97
KANTER, C.V. 125
KATZ, J. 353
KEMNITZ, D.A. 377
KEUL, W. 354
KNOP, W. 105
KOGAN, L.A. 165
KOGLIN, W. 314
KOLAR, J. 415, 416
KOLBOW, P. 293
KONIG, W. 227, 457
KRAUSE, U. 417, 469
KRAYUSHKIN, I.F. 106
KRON, L.C. 18
KRUGER, R. 315
KUBALEK, J. 259
KUNKEL, H.E. 58
KURFURST, J. 418
KUSIAN, R.N. 107

L

LANE, W.R. 275
LANG, N. 419
LANGEJAN, J.J.D. 276, 422
LAPPLE, C.E. 45
LARSSON, O. 420
LAUFHÜETTE, D.W. 421
LAWSON, A.T. 240
LEES, B. 203, 204
LEONARD, J.S. 316
LEROY, P. 162
LEVIN, E.D. 165
LIEBERMAN, A. 112, 388, 448
LITTLE, A.D. INC. 142
LIU, B.Y.H. 473
LOGAN, T.J. 368
LUCAS, D.H. 218, 219, 220, 355, 389, 479
LUNCHE, R.G. 125
LUNDGREN, D. 356
LUPTON, H.P. 205
LÜTH, F. 23

M

McCUTCHEN, G.D. 206
MACKENZIE, J.W. 17
McMAHON, H.E. 58
McSHANE, W.P. 390
MAGILL, P.L. 121
MAGNUSZEWSKI, A. 317
MAKINO, N. 64
MAKSIMOV, V.F. 228
MANDERSLOOT, W.G.B. 357
MARTIN, R.M. 368, 470
MASCHINENFABRIK BETH 147
MASCHINENFABRIK HARTMANN 242
MASTROLILLI, M. 437
MATOI, H.J. 88, 111
MATOUSCHEK, F. 186
MATSAK, V.G. 76
MAURER, O. 449
MAZUROV, D.Y. 106
MEIER, G. 158
MELLOR, D. 109
MIETHING, H. 10
MION, J. 391
MITCHELL, R.I. 260
MODDE, P. 322
MONASTYREV, A.V. 433
MONSTADT, H. 392
MOORE, A.S. 261
MOORE, C.B. 10, 172, 229
MORI, O. 412

MORLEY, M.C. 203, 204
MORROW, N.L. 480
MUELLER, H. 262, 263, 322
MUHLRAD, W. 117, 318
MURAKAMI, T. 241
MURRAY, J.J.L. 132
MUSCHELKNAUTZ, E. 110

N

NAGAMI, Y. 450
NAGEL, R. 117, 131, 242
NARJES, L. 227, 294, 295, 393
NATIONAL COUNCIL FOR STREAM IMPROVEMENT INC. 243
NEUMANN, G. 13
NEWELL, G.W. 122
NICHOL, A.A. 122
NONHEBEL, G. 278
NOSS, E. 117
NOSS, P. 77, 207 230

O

ONLIN, J.G. 473, 474
OLSSON, S. 423
OPARYSHEVA, V. 424

P

PANOF, S. 435, 436
PARKER, G.J. 394
PARKES, W.J.S. 249
PARKINSON, M.J. 395
PATRICK, E.A.K. 47
PATTON, W.F. 244
PAYTON, E.J. 272
PENGELLY, A.E.S. 245
PETERS, D.L. 358
PETRUSCH, V. 298
PIETRZYK, Z. 187
PILNEY, J.P. 473
POHLMAN, R. 188
POLANIECKI, E. 317
POPIL'SKII, M. 31
PORTHOUSE, J.D. 268
POSTMA, A.K. 231
PRINCEN, L.H. 264
PROCHAZKA, R. 102, 122, 136, 175, 238, 246, 279, 280, 319, 396

SEHMEL, G.A. 326, 363, 364, 365, 366, 453
SEIBERT, C.B. 66
SEILER, P.E. 400
SEM, G.J. 473, 474
SEPTIER, L. 162
SERPER, A. 475
SEXTON, R.W. 282
SHALE, C.C. 97
SHAW, W.F.B. 113, 145
SHERMAN, P.R. 367
SHEVCHENKO, N.S. 165
SHIGEHARA, R.T. 331, 454
SHIRASAWA, T. 427, 458
SHORT, W. 327, 401, 455
SIEGMANN, H.C. 200
SIEMENS-SCHUKERTWERKE A.G. 8
SILVERMAN, L. 53, 69, 72, 92, 114, 133, 283, 290
SIMON, A.W. 14, 18
SJOGREN, A. 476
SKAGGS, H.C. 284
SMITH, B.O. 78
SMITH, J.H. 88, 146
SMITH, N.F. 172
SMITH, N.S. Jr 456
SMITH, W.J. 171
SMITH, W.S. 368, 454
SMITHSON, D.J. 380
SMITHSON, R.N. 380
SNOWSHILL, W.L. 218, 219, 220, 355, 389, 479
SOLBACH, W. 147, 232
SOLNICK, R.L. 126
SOO, S.L. 426
SPOHR, F. 441, 442
STAIRMAND, C.J. 65, 79
STARK, S.B. 446
STEELE, D.H. 217
STEIN, J. 233
STEPHENS, J.F. 234
STERN, A.C. 24, 402
STEVENS, P.G. 109
STOCKMAN, J.D. 477
STOECKER, W.F. 59
STONE, P.E. 66
STÖNNER, A. 457
STRAHUBER, F. 13
STRAUSS, W. 328
STREDA, I. 115
STUKEL, J.J. 426
SUPRENANT, N.F. 108, 172
SWAN, A. 172

T

TAMORI, I. 427, 458
TAYLOR, B.G.S. 233
THIBAULT, C.G. 116
THIEME, W. 300
THIENE, R. 293
THOMAS, J.W. 163, 164
THOMSON, R.M. 7
TODD, W.F. 454
TOHATA, H. 148
TOUZALIN, L.A. 1
TOWNSEND, L.B. 448
TOYNBEE, P.A. 249
TROYANKIN, Y.V. 127
TUBICH, G.E. 67

U

UETAKI, T. 459
UZIMA, M. 369

V

VAN WAVEREN, K. 131
VARSHAVSKII, T.P. 165
VEREIN DEUTSCHER INGENIEURE 117, 329
VERROCHI, W.A. 353
VETTER, H. 428
VIETS, F.H. 21
VITOLS, V. 285, 301
VOLKERY, W. 411

W

WADE, G.R. 233
WAINWRIGHT, H.W. 66, 97
WALKER, V. 89
WALTER, E. 118, 149, 166, 250
WASILEWSKA, J. 417
WASSER, R.W. 167
WATSON, C.H. 18
WATSON, H.H. 98
WEBER, H.J. 235
WEBER, M. 330
WERTHOF, K.A. 349
WESTGLADE ELECTRICS CO. 403
WESTLIN, K. 119
WHITELEY, A.B. 190
WHITMORE, J. 11
WIEDERHORN, N.M. 171, 172, 229
WIEMER, P. 208, 230

WILCOX, J.D. 120
WILHELMI, A. 30
WILSON, A.C. 251, 272
WINKEL, G. 370
WOLFE, E.A. 236, 252
WOLTERS, K. 188

Y

YAFFE, C.D. 128
YURENEV, V.N. 466
YUSHMANOV, E.V. 31, 38

Z

ZABIYAKO, V.N. 38
ZENKER, P. 404, 478
ZIMMERMANN, E. 19
ZIMMERMANN, I. 296

EEAR/SG

4 SUBJECT INDEX

NB Numbers after entries are references, not page numbers.

AEG optical monitor see Monitors
AEI monitor see Monitors
A.I.S.I. monitor see Monitors
Acid 282, 286
Acoustical methods 266
  - attenuation of ultrasound 188, 260, 395, 465
  - sensors 397
Adsorption of SO_3 281, 336, 337
Aircraft sampler 73, 429, 451
Alundum probe see Probes
Alundum thimble see Filters
Anisokinetic error see Errors
Anisokinetic sampling see Sampling
Askaniawerke A.G. monitor see Monitors
Atomic plants 182
Automatic sampling see Sampling

B.C.U.R.A. probe see Probes
B.E.A. probe see Probes
B.I.S.R.A. monitor see Monitors
B.I.S.R.A. probe see Probes
B.P. probe see Probes
Baffles 40, 42, 46, 65, 71, 79, 94
Bags see Filters
Belt filter see Filters
Bends in ducts, probes see Errors
Beta-radiation see also Radiation
  - absorption of 187
  - attenuation of 189, 225, 226, 260, 273, 288, 306, 308, 325, 338, 378, 385, 390, 395, 408, 413, 419, 441, 443, 447, 452, 465, 475

BEWAG probe see Probes
Blast furnace see Furnaces, see also Metallurgical Industry
Boilers 17, 24, 26, 125, 163, 167, 224, 233, 269, 300, 332, 348, 376, 431, 443, 455
Bolometer 350, 475
Broken Hill Associated Smelters (Pty) Ltd. 4

C.E.G.B. monitor see Monitors
C.E.R.L. monitor see Monitors
C.S.I.R. probe see Probes
Calculation 43, 55, 65, 76, 83, 85, 103, 116, 125, 129, 166, 178, 194, 209, 222, 224, 234, 257, 301, 313, 314, 329, 341, 367, 381, 387, 406, 422, 432, 458
Capacitors 8, 135, 344
Cascade impactor 65, 93, 108, 155, 311
CEGRIT monitor see Monitors
Cement works 101, 105, 132, 237, 382, 442
Ceramic thimbles see Filters
Coal 9
Coke ovens 165
Concentration profile 40, 42, 65, 71, 77, 79, 334, 361, 362, 412, 425, 453
Condensation 6, 33, 43, 62, 81, 164, 209, 307, 322
Cost 55, 85, 398, 439, 440
Cupolas 67, 235, 372, 402
Cyclones 6, 24, 33, 51, 65, 81, 85, 100, 103, 105, 118, 134, 166, 186, 191, 192, 209, 224, 229, 244, 251, 273, 287, 296, 322, 328, 382, 402, 431, 476

Deposition in probes see Errors
Dielectric measurement 214, 260
Domestic heating units 434

E.P.A. probe see Probes
Electrical methods 64, 135, 159, 200, 214, 238
 - capacitors 8, 135, 344
 - piezoelectric sensor 279, 397
 see also Electrostatic Contact Charge Transfer, Electrostatic Ion Capture, Electrostatic Surface Area Meter, Triboelectric effect
Electric furnace see Furnaces, see also Metallurgical Industry
Electrodynamic principle 456
Electrostatic Contact Charge Transfer 102, 136, 174, 184, 265, 280, 288, 289, 319, 320, 324, 325, 344, 347, 378, 386, 396, 415, 416, 421, 424, 452, 465
Electrostatic Ion Capture 200, 256, 260, 271
Electrostatic Precipitator 7, 11, 42, 47, 54, 65, 72, 83, 88, 108, 111, 122, 176, 197, 209, 229, 422
Electrostatic Surface Area Meter 193, 199, 229, 239, 302
Equal areas 17, 85, 103, 129, 209, 216, 224, 255, 329, 331, 402, 467

Errors 59, 85, 117, 143, 172, 186, 219, 227, 249, 271, 276, 314, 329, 336, 337, 347, 374, 375, 406, 420, 452, 467, 479
- due to adsorption of SO_3 281, 336, 337
- anisokinetic 1, 16, 17, 19, 26, 33, 46, 65, 83, 95, 98, 103, 116, 139, 142, 158, 169, 170, 194, 224, 275, 277, 278, 285, 301, 341, 356, 363, 364, 388, 392, 399, 404, 436, 453, 454, 465, 472
- due to bends in duct 334, 361, 362, 425
- due to bends in probe 142, 365, 453, 472
- due to deposition in probe 83, 95, 142, 163, 231, 366, 388, 394, 453, 465, 472
- due to nozzle shape 46, 65, 142, 149, 166, 190, 208, 356, 394, 436, 472
- due to nozzle size 37, 44, 65, 95, 98, 120, 142, 230, 297, 453, 465, 472
- due to null principle 83, 95, 133, see also Null Principle
- due to probe orientation 16, 19, 33, 98, 116, 120, 158, 275, 278, 329
- due to turbulent flow 472
- due to yaw 16, 19, 33, 98, 116, 120, 158, 275, 278, 329

ESSO probe see Probes
Everclean Window 220, 355, 479

Ferrosilicon 114
Fertiliser plants 156, 358, 445, see also Superphosphate plant
Fibre optic probe see Probes
Filters 2, 4, 5, 6, 12, 13, 19, 22, 33, 51, 65, 72, 87, 97, 103, 104, 105, 108, 119, 121, 126, 1[illegible]9, 157, 165, 229, 235, 244, 270, 283, 292, 340, 353, 381, 383, 384, 402, 442, 472, 475, 476
- adsorption of SO_3 281, 336, 337
- alundum thimble 33, 49, 52, 83, 95, 101, 209, 252, 328, 329, 475
- belt filter 225, 273, 292, 308, 475
- ceramic thimble 65, 477
- glass cloth bag 49, 52, 475
- glass fibre disc 270
- glass fibre thimble 209, 328
- glass wool filter 33, 38, 65, 81, 224, 233, 329, 336, 337, 427
- metal screen 33, see also Stainless Steel
- paper 209, 241
- paper thimble 1, 2, 33, 65, 83, 119, 183, 209, 270, 328, 329, 367, 475
- silica wool 281, 359
- slag wool 65, 81
- stainless steel 65, 233, 252, see also Metal Screen
- Teflon 358, 477
- woven cloth bag 33, 83, 85, 181, 191, 192, 209, 268, 292

Flow pattern	see Particle trajectory, see also Turbulent flow
Fluorides	358, 377, 383, 440
Fordust monitor	see Monitors
Foundries	396, see also Cupola, Metallurgical Industry
Fumes	7, 62, 114, 123, 258
Furnaces	see also Metallurgical Industry
- basic oxygen	390
- blast	1, 14, 30, 36, 89, 103, 116, 184, 413, 424
- electric	114, 130, 258, 367
- oil-fired	141, 233, 281, 327, 349, 354, 462, 463, 467
- open-hearth	88, 127, 146
Gas distribution systems	171
Gases	
- high pressure	126, 320, 321, 322
- high temperature	320, 321, 340
- inflammable	47
- moist	6, 47, 119, 164
Gas turbine	261, 429
Generator gas	see Producer gas
Glass fibre filter	see Filters
Glass spheres	283
Glass works	477
Granulating plant	see Fertiliser plant
Heat capacity	9
High temperature probe	see Probes, see also Gases - high temperature
High velocity streams	73, 133
Hot gas	see Gases - high temperature
Hot wire	229, 255, 291, 342, 397, 409, 410
Impact momentum sensing	397, 409
Impingement sampler	see Samplers
Incinerators	68, 125, 163, 297, 340, 402, 448, 468
Isokinetic momentum probe	see Probes
Isokinetic sampling	see Sampling
James Howden & Co. probe	see Probes
Konitest monitor	see Monitors
Kraft mill	183, 316, see also Paper mill

Light scattering	see Optical methods
Light transmission	see Optical methods
Lime kiln	433
Locomotives	85
Lodge-Cottrell probe	see Probes
Magnetic permeability	36
Mancuna sampling train	see Sampling trains
Manifold nozzle assembly	94, 295, 411
Metallurgical industry	4, 49, 180, 367, 379, 390, 442, 466, see also Cupolas, Foundries, Furnaces, Steel works, Thomas converter
Metal screen filter	see Filters
Microbalance	138, 176, 197, 198, 306, 310, 378, 465
Micromax optical monitor	see Monitors
Mist	22, 76, 244, 275, 282, 286, 328, 358, 394, 397, 410
Moist gases	see Gases
Momentum change	56, 131, 259, 330, 378, 409
Monitors	7, 9, 14, 18, 20, 30, 78, 102, 148, 171, 172, 174, 175, 182, 184, 197, 198, 200, 211, 214, 217, 218, 219, 223, 225, 226, 229, 247, 248, 265, 269, 271, 272, 273, 283, 288, 289, 290, 292, 293, 302, 306, 309, 310, 320, 321, 325, 338, 347, 355, 385, 386, 398, 390, 395, 408, 419, 421, 428, 443, 448, 452, 456, 460, 465, 474, 475, 479
- AEG optical monitor	250
- AEI	193, 199
- A.I.S.I.	390
- B.I.S.R.A.	90
- C.E.G.B.	251, 287
- C.E.R.L.	253, 389, 479
- Askaniawerke A.G.	9
- CEGRIT	251, 287
- Fordust	403
- Konitest	102, 136, 181, 196, 210, 212, 223, 227, 238, 250, 280, 288, 289, 319, 325, 378, 386, 396, 415, 416, 424, 452
- Serop	371
- Siemens	8, 10, 449
N.A.P.C.A. sampling train	see Sampling trains
N.C.B. probe	see Probes
Nephelometer	see Optical methods, Scattered light
Nozzles	
- errors due to	see Errors
Nuclear plants	182
Null principle	5, 11, 22, 33, 52, 83, 95, 103, 104, 105, 116, 117, 119, 126, 129, 133, 158, 208, 209, 230, 249, 277, 294, 295, 318, 328, 329, 348, 357, 376, 391, 393, 402, 409, 411, 480

Oil fired furnace	see Furnaces
Open hearth furnace	see Furnaces
Optical methods	54, 78, 82, 134, 172, 181, 253, 254, 371, 405
- scattered light	32, 78, 134, 172, 229, 247, 403, 408, 443
- transmitted light	18, 20, 21, 59, 63, 66, 181, 217, 218, 219, 220, 247, 260, 262, 263, 269, 272, 288, 289, 293, 323, 325, 347, 350, 355, 378, 408, 421, 426, 443, 452, 465, 479
P.H.S. probe	see Probes - E.P.A. Probe
Paper filter	see Filters
Paper mill	109, 183, 243, 316, see also Kraft mill
Particle trajectory	139, 149, 169, 285, 301, 305, 341, 346, 363, 364, 374, 375, 399, 414
Phosphoric acid	440
Photoelectrical methods	63, 66, 90, 211, 309, 317, 323, 369, 403, 428, 449, 460, 475
Photography	305
Piezoelectric effects	see Electrical methods
Pilot plant	276
Pneumatic conveying	131, 189, 294, 295, 393, 409, 457
Power stations	40, 96, 167, 222, 269, 272, 338, 347, 416, 428, 463
Pressure drop	see Momentum change
Probes	1, 2, 11, 12, 17, 19, 22, 33, 39, 40, 42, 43, 51, 52, 57, 58, 60, 61, 69, 77, 83, 100, 104, 105, 107, 116, 117, 118, 121, 129, 134, 146, 149, 158, 166, 183, 185, 190, 209, 216, 221, 230, 249, 261, 272, 316, 328, 342, 348, 353, 357, 359, 368, 376, 380, 381, 382, 384, 394, 402, 405, 429, 450, 461, 476, 477
- B.C.U.R.A. probe	75, 98, 140, 157, 202, 224, 328, 332, 344, 402, 432, 455
- B.E.A. probe	80, 81, 96
- B.I.S.R.A. probe	123, 140, 151, 152, 153, 154, 179
- B.P. probe	312, 344
- C.S.I.R. probe	422, 445
- E.P.A. probe	368, 440, 454, 470, 480
- N.C.B. probe	431
- alundum	101, 132
- bends in	see Errors
- BEWAG probe	186
- deposition in	see Errors
- ESSO probe	233
- fibre-optics probe	426
- heating of	65, 81, 322, 377, 422, 433
- high temperature probe	141, 151, 152, 153,, 154, 179, 245, 322, 328, see also Gases - high temperature
- isokinetic momentum probe	471
- James Howden & Co. probe	48

  - Lodge Cottrell probe 101, 384
  - shell probe 437
  - venturi probe 57
  - vessel probe 414
  - water-cooled probe 141, 245, 328
Producer gas 3, 13, 47, 97, 140
Pulverised fuel 9, 46, 294, 295, 393, 411, 457

Radiation
  - attenuation of 292, 457, see also Beta-radiation
Radioisotopes 182
Reflection of light see Optical methods
Rotary kilns 106
Resonant frequency 344

Samplers
  - aircraft sampler 73, 429, 451
  - impingement sampler 93, 119, 157, 203, 204
Sampling see also Total sampling
  - anisokinetic 34
  - automatic 112, 180, 444, 448
  - isokinetic 1, 2, 6, 11, 12, 17, 22, 33, 48, 50, 52, 55, 57, 65, 72, 76, 83, 85, 95, 97, 104, 105, 112, 120, 133, 141, 149, 151, 166, 169, 170, 180, 197, 208, 224, 235, 245, 249, 264, 278, 282, 294, 297, 301, 305, 318, 326, 328, 329, 341, 342, 349, 354, 356, 359, 361, 362, 367, 368, 375, 391, 393, 399, 402, 404, 409, 411, 422, 426, 432, 440, 445, 446, 448, 451, 466, 470, 475
Sampling location 33, 55, 65, 97, 103, 114, 129, 181, 183, 209, 216, 224, 278, 297, 316, 329, 331, 332, 376, 400, 432, 440, 450, 458, 467, 475, 480
Sampling procedure 15, 39, 40, 41, 43, 58, 60, 61, 65, 83, 85, 88, 92, 121, 129, 137, 142, 166, 167, 209, 216, 224, 234, 257, 282, 297, 304, 329, 331, 332, 351, 357, 377, 381, 384, 400, 402, 406, 439, 458, 459, 464, 467
Sampling time 129, 224, 400, 440
Sampling trains 83, 85, 103, 114, 129, 181, 209, 286, 340, 379, 439, 464, 480
  - B.A.A.P.C.D. sampling train 480
  - L.A.A.P.C.D. sampling train 480
  - N.A.P.C.A. sampling train 206
  - II A6 sampling train 206
  - Mancuna sampling train 191, 192
  - Visco-isokinetic sampling train 213
Scattering of light see Optical methods
Scrubber 33, 49

Serop monitor see Monitors
Siemens monitor see Monitors
Silica wool filter see Filters
Sinter plant 396, 446
Slag wool filter see Filters
Slide rule 50
Small ion see Electrostatic ion capture
Sound attenuation see Acoustical methods
Specific heat see Heat capacity
Stainless steel filter see Filters
Standards 40, 41, 129, 400
Steel works 23, 151, 152, 153, 154, 162, 240, 258, 290, 298, 380, 390, 413, 417, 424 see also Metallurgical industry
Sulphate pulping 183, 316, see also Paper mill
Sulphuric acid manufacture 38, 148
Sulphur trioxide adsorption see Errors, see Filters
Superphosphate plant 358, see also Fertiliser plants
Surface area meter, electrostatic 193, 199, 229, 239, 302

Tar 3, 13, 140
Teflon filter see Filters
Thermal precipitator 62, 93, 108, 328
Thermistor 370, 407
Thimble see Filters
Thomas converter 298, see also Metallurgical industry, Steel works
Total sampling 268
Training for sampling 398, 455
Trajectories see Particle trajectories
Transmittance of light see Optical methods
Triboelectric effect 307, 321, see also Electrical methods
Turbulence, errors due to see Errors
Turbulent flow 291, 409, 435, 436

Ultrasound, attenuation of see Acoustical methods
Unsteady processes 313, 331, 379, 387, 444, 467

Venturi 56, 131, 180, 259, 330, 378, 409
Venturi probe see Probes
Venturi transducer 279
Vessel probe see Probes
Visco-isokinetic sampling train see Sampling trains
Visual estimation 21

Water-cooled probe see Probes
Woven cloth filter see Filters

Yaw, errors due to see Errors

EAR/SG